POWER PLANT ENGINEERING

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EDITORIAL STAFF — ARTHUR L. RICE, Editor; R. E. TURNER, Managing Editor; A. W. KRAMER, Associate Editor; CHESTER R. EARLE, Associate Editor; RICHARD H. MORRIS, Associate Editor; EDWARD J. KUNZE, Associate Editor

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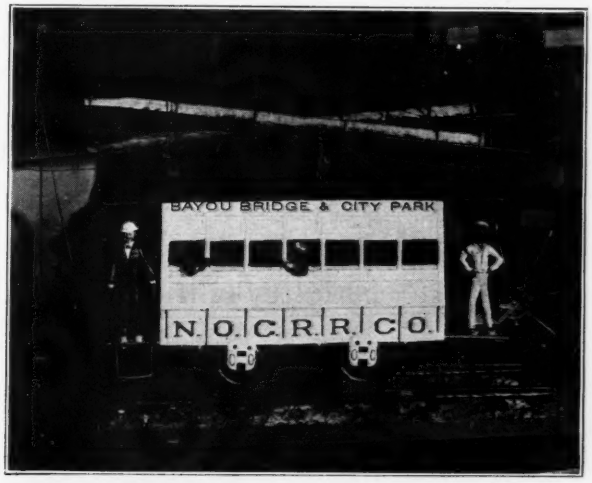


Walking in the Sinful Sixties

MULES AND HORSES ruled supreme in the street car world of the Civil War period in New Orleans. Fair ladies in crinoline and Beau Brummels in the frock coats and high hats of that day, took their lives in their hands when boarding one of the new fangled, devilish contrivances to bowl along at the legal limit of four miles per hour.

Even war could not dampen the inventive spirit of the age, however, and according to H. L. Blain in "A Near Century of Public Service in New Orleans," some young enthusiast offered walking cars of the type shown above to the New Orleans City Railroad Co. about 1866. The motorman turning the front wheel operated the rimless rear or driving wheel through a series of gears, levers and beams. Spokes on the rear wheel ended in iron balls which caught on the ground or ties to push the car along. If this type of car had been adopted, the walking riders would have been half a century before their time, considerably ahead of the modern suburbanite who today walks to and from work on the subway or elevated.

Then as now, new equipment served to create interest, not only because of what direct application might be made of it but because such developments are a reliable index of progress and an undisputable measure of the effort being made to solve the world's mechanical problems.

From the sixties to the present time is almost three-quarters of a century but new inventions and developments continue at an ever increasing rate. Some of the important equipment developed by manufacturers during the past year in the power plant field are reviewed in this issue beginning on page 102.

Unfailing Power, Mountain Air and Pure Water in Broad St.

Heating, Ventilating, Lighting and Elevator Service Are Planned for the Convenience of Every Occupant of the Fidelity-Philadelphia Trust Bldg.

IN ARCHITECTURAL design and in conveniences to the tenants, the Fidelity-Philadelphia Trust Building, completed in the spring of 1928, is in every respect a model American office building. This new building is owned and operated by the Fidelity Building Corp. and is located on the northeast corner of Broad and Walnut Sts., Philadelphia, Pa. The main office of the Fidelity-Philadelphia Trust Co. occupies the first six floors and basements A and B, excepting the north wing on Sansom St., which is devoted to the office building entrance, elevator lobbies and certain limited rentable areas. Simon and Simon, of Philadelphia, the architects, have used a modified classic style of architectural decoration, adapting it to the requirements of this bank and office building. Their plans and specifications have been carefully executed by the general contractors, Irwin and Leighton.

Exclusive of three basements, the building is 30 stories high, rises 377 ft. above the sidewalk, has 618,000 sq. ft. of net usable area and 11,500,000 cu. ft. of volume. It is estimated that the population of the building will exceed 5000 persons. The mechanical plant, electric transformers and switchboard are located in basement C.

Twenty Passenger Elevators Serve Building

Particular attention has been given to the 20 passenger elevators which are divided into two groups, or banks, as they are generally known. One bank serves the first to the seventeenth floor and the other above the seventeenth floor. These elevators, capable of attaining a speed of 700 to 800 ft. per min., are equipped with mechanically operated doors and gates, automatic leveling device, and with signal control. In addition to the passenger elevators, there are two freight or service elevators. Separate from these in the space occupied by the Trust Company are six passenger elevators and two cash or book lifts.

Throughout usable areas, the building is equipped with under floor ducts for light, power, telephone and signal wires, thus eliminating open wiring without loss of flexibility in locating such services.

General arrangement of the office building space was planned in consultation with the National Association of Building Owners and Managers. The general plan of the upper floors is in the form of an H, with open courts approximately 60 ft. in depth and 100 ft. across, thus assuring abundance of light. A system of ventilation whereby clean, fresh air is forced in and used air drawn out has been installed throughout all parts of the banking space.

Fire alarm boxes are located on all floors at the head of the stairway and it is expected that all other emergencies will be telephoned directly to the superintendent's office.

Electric service comes to the building through two feeders from two different substations of the Philadelphia Electric Co. In the event of a shutdown on one service, the other independent supply will automatically take its place. As a precaution against any further contingencies, the building is provided with a storage battery to provide emergency lighting in corridors and elevators.

Steam Power Supplements Electric for Pumping

Steam for heating the building and operating auxiliary pumps is furnished by five Casey-Hedges water-tube boilers, built for a working pressure of 160 lb. per sq. in. Two of these boilers are rated at 185 hp. and three at 413 hp., making a combined normal horsepower 1609. These boilers are served by McClave anthracite stokers of the hand operated type. The fuel used at present is anthracite rice, which comes to the plant in trucks and is delivered to bins under the sidewalk, two of which are provided, having a total capacity of 500 t. From the bins the coal is dropped into industrial cars operated by storage batteries, the cars having a capacity of ¾ t. Fairbanks-Morse scales, on which the fuel is weighed as it passes to the boilers, are provided along the tracks for the industrial cars. Ashes from the boilers

are carried in industrial cars to a hydraulic lift which carries them 5 ft. above the level of the pavement for discharge into trucks for disposal.

Three 6000-gal. oil tanks have been installed for fuel oil in case future conditions render its use desirable. Control of combustion is accomplished by means of the Gray system which regulates the forced draft and operates the individual uptake dampers.

One forced draft fan is provided which takes the air from the top of the boiler and pump rooms and delivers it to the under side of the grate. This is a Clarage fan, operated by a 30-hp. motor of the induction slip ring type and is capable of operating at 11 different speeds. Each boiler is provided with Bailey draft gages which indicate the draft under the grate, in the furnace and in the uptake.

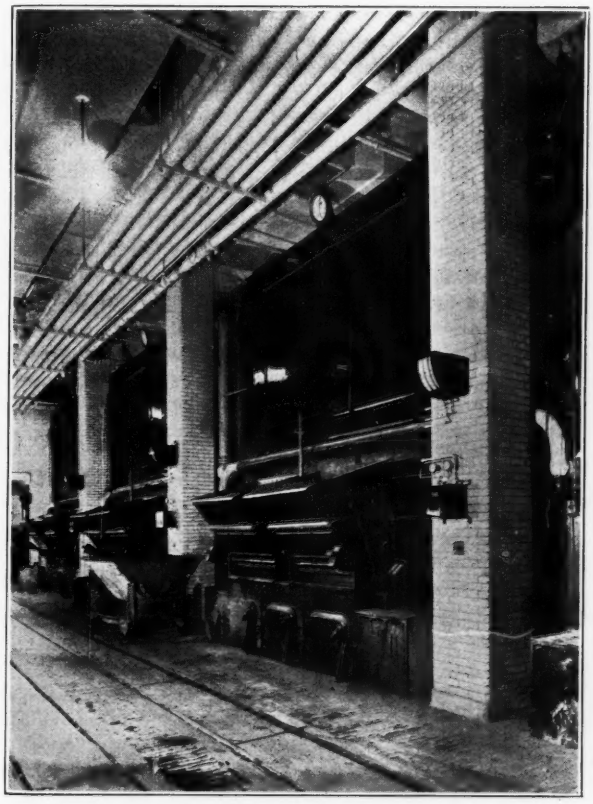


FIG. 1. BOILERS ARE SERVED BY HAND STOKERS BURNING ANTHRACITE

On each boiler are three blowoff connections, one at the rear, one at the surface and the third on the front header.

Being of elliptical shape, the stack is 5 ft. 6 in. by 6 ft. 6 in. in cross-sectional dimensions and the height is 408 ft. It is of steel, supported from the base and is lined 50 ft. with 2½-in. Sil-O-Cel brick. The enclosure around the stack is made of hollow tile and is insulated with Nonpareil cork brick. In order to prevent flue gases from an adjoining building from being an annoyance to tenants, a connection is made at the fourteenth floor through which all the discharge gases from the adjoining building enter the Fidelity Building, from which they are discharged through a separate stack at a height which avoids any complaint from tenants. Each boiler is provided with a Brown Instrument Co. electric CO_2 instrument and stack temperature recorder.

Welded Piping Used Throughout

Steam leads from the boilers are 6 and 8 in. in diameter and connect to a header at the rear which is conveniently located just above the boiler room floor and sectionalized by means of a valve. Throughout the entire building, the piping is welded except where valves are needed, in which case flanges are provided.

Feedwater is drawn from the service lines and condensation tank and heated in a Webster open type feedwater heater which takes exhaust from the pumps. The temperature of the feedwater is recorded as it enters the boilers on a Brown recording thermometer.

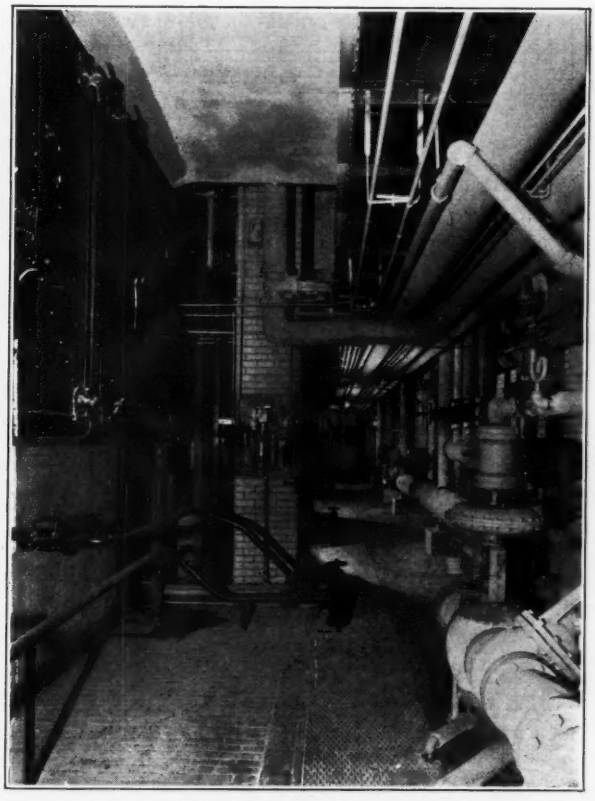


FIG. 2. MAIN STEAM HEADER AT THE REAR OF THE BOILERS

Compressed Air Ejects Sewage

All sewage above the first floor goes directly to the city sewage system, but below that it drains to a sump in a room off the south end of the boiler room where two air ejectors are provided for delivery to the sewage system. To operate these ejectors, two Ingersoll-Rand air compressors furnish air at 100 lb. pressure which is reduced to 40 lb. for use. If the Ingersoll-Rand compressors, which are motor driven, should fail, compressed air may be supplied by two steam driven Westinghouse vertical air compressors, located in the boiler room. Two Yeomans Bros. heavy duty bilge pumps discharge clear water drainage from the boiler room and overflow from tanks from a sump to the city sewage system.

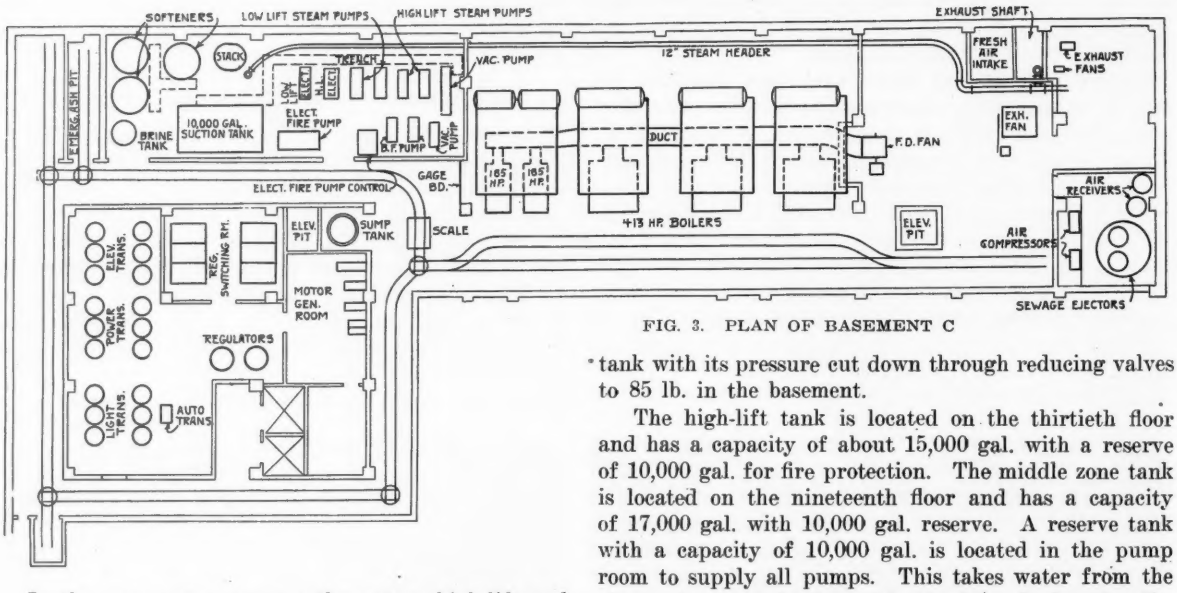


FIG. 3. PLAN OF BASEMENT C

In the pump room are one three-stage high-lift and one two-stage low-lift motor driven pumps. Two duplex low-lift and two duplex high-lift service pumps and two duplex boiler feed pumps are operated by steam under the control of Fisher governors. There are also one Warren steam vacuum pump and one Skidmore motor driven vacum pump. Four condensate meters manufactured by the American District Steam Co. are also located in the pump room. An instrument board indicates the conditions of pressure on equipment in this room.

Water Service for the Building

In the water service system, three pressure zones are maintained. The high-pressure zone covers the seventeenth to the thirtieth floors and is under a pressure of 180 lb. in the pump room, the zone being served by two steam and one electric pump. The medium-pressure zone serves the sixth to the sixteenth floors, the boiler room pressure being 114 lb. supplied by one electric and two steam pumps. The low-pressure zone serves up to the sixth floor, the water coming from the middle zone tank with its pressure cut down through reducing valves to 85 lb. in the basement.

The high-lift tank is located on the thirtieth floor and has a capacity of about 15,000 gal. with a reserve of 10,000 gal. for fire protection. The middle zone tank is located on the nineteenth floor and has a capacity of 17,000 gal. with 10,000 gal. reserve. A reserve tank with a capacity of 10,000 gal. is located in the pump room to supply all pumps. This takes water from the city main through three 5-in. leads and also the discharge from the refrigeration condensers. All water used in the building is treated by a Permutit water softening system, three softeners being provided, and two Elliott deaerators are provided for treating the water to be heated for building service.

Hot water piping is of the circulating type which prevents the waste of considerable water. Pumps used for circulating the hot water in the service of the build-

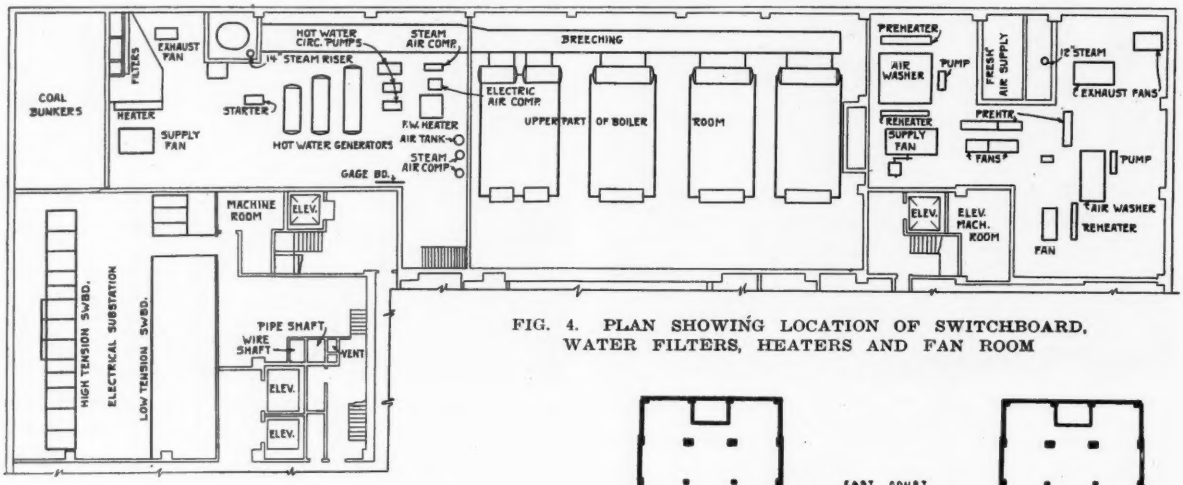


FIG. 4. PLAN SHOWING LOCATION OF SWITCHBOARD, WATER FILTERS, HEATERS AND FAN ROOM

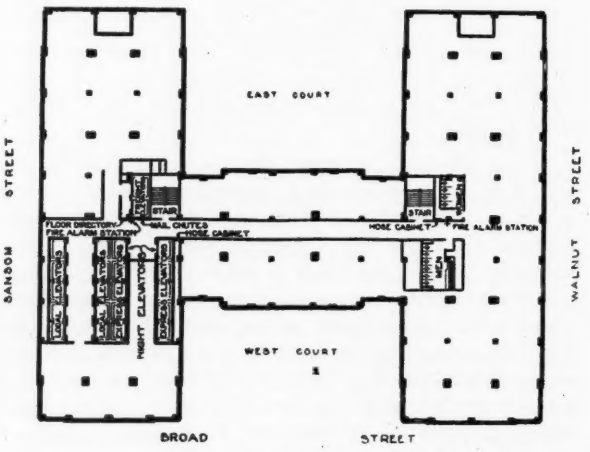


FIG. 5. FLOOR PLAN OF TYPICAL RENTABLE FLOOR

ing are three in number, the high-pressure pump being a Warren 2-stage centrifugal, driven by a General Electric 5-hp. motor. The intermediate pressure pump is driven by a General Electric 5-hp. motor and is a Warren single stage pump. The low-pressure pump is a Warren single stage, driven by a General Electric motor of 3-hp. capacity. The water is heated by exhaust or live steam in the Elliott deaerators as the case necessitates; one Whitlock booster heater being provided for each of the three zones. These are regulated by Fulton Sylphon Co. regulators set to give the water a temperature of 160 deg.

For controlling the electric pumps, delivering water to the nineteenth and thirtieth floor tanks, Sundh Electric Co. control is employed. These tanks are equipped with high and low water alarms and direct reading level indicators.

To provide protection against fire, a three-stage Warren fire pump is installed, with a capacity of 1000 g.p.m., driven at 1745 r.p.m., by a 200-hp., 2400-v., 3-phase General Electric motor. This is controlled automatically by a Sundh Electric Co. control board. The sprinkler system was furnished by the Globe Automatic Sprinkler Co. and is installed in the bank and basement floors, the wet system being employed.

Four fire hose outlets are located on each floor and at those in the corridors a cabinet containing hose and fire extinguisher is provided. Three Siamese connections are on the street outside for connection to fire engines. This piping was installed at the time the steel construction work was going on so that during all the construction work, fire protection was provided.

Automatic Refrigeration for Drinking Water

Drinking water is cooled by an automatic refrigerating system consisting of two 10-t. Frick ammonia compressors, driven by 20-hp. General Electric induction motors using current at 220-v., 3-phase. Water is sterilized in an automatic Forbes water sterilizer having a capacity of 250 gal. per hr. This supplies all the drinking water fountains in the bank part of the building.

Two cooled drinking water pumps are provided for circulating the water in an 800-gal. storage system.

Two brine systems are installed; one to the kitchen on the fifth floor is carried at 90 lb. pressure and another to the kitchen on the twenty-eighth floor which, though not yet in service, will be carried at 150-lb. pressure. The brine temperature is maintained at 15 deg. F.

Cooling water for the ammonia condenser comes from the nineteenth floor tank through the coolers, then to the pump suction tank.

Conditioned Air in Heating and Ventilating System

In the heating system there is one 14-in. riser on the north end of the building and one 12-in. riser on the south end which feed a distributing loop in the pipe loft between the twenty-second and twenty-third floors. These feed down to the sixth floor and up to the thirtieth floor. A main around the basement feeds to the fifth floor and the portion of the sixth floor occupied by the bank. Two 8-in. mains go to the air conditioning equipment in the basement and a 5-in. high-pressure line to the kitchen and air conditioner on the fifth and sixth floors. This is a Warren Webster

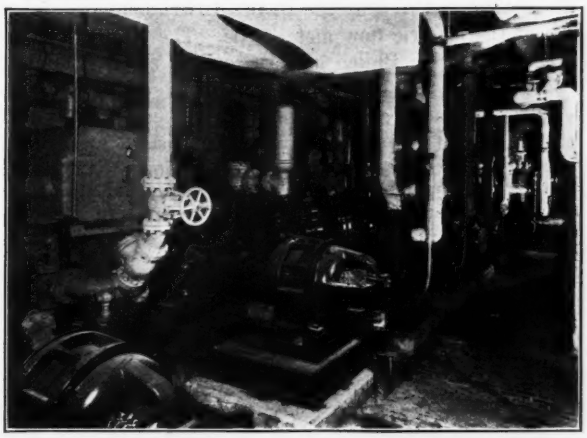


FIG. 6. MOTOR PUMPS ARE SUPPLEMENTED BY STEAM PUMPS IN SERVICING THE BUILDING

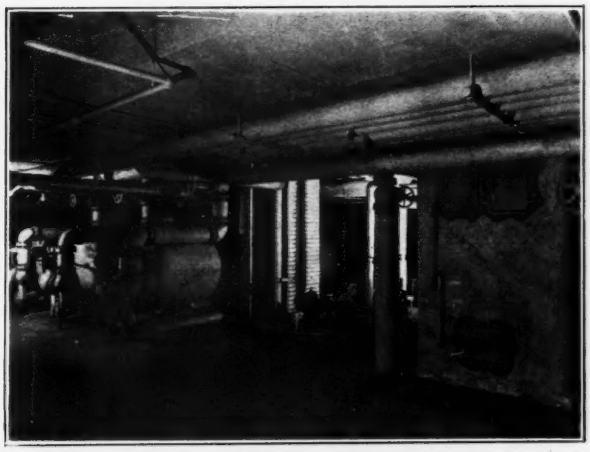


FIG. 7. WATER HEATERS AND FEEDWATER HEATER ARE LOCATED IN ROOM ABOVE MAIN SERVICE PUMPS

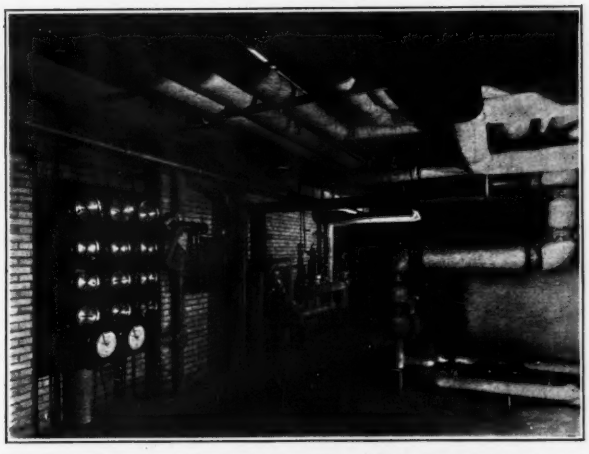


FIG. 8. GAGE BOARD AND PIPE HEADER IN HEATER ROOM

heating system, operating at 1 lb. pressure, controlled by Johnson service, the reducing valves being located in the boiler room. The condensate is returned to the feedwater heater.

Each of the heating lines supplies direct radiation and is provided with a flow meter. There are two of

these manufactured by the Brown Instrument Co. which are of the electric flow meter type. The electric meters are operated by Philco batteries which employ Tungar chargers.

The Johnson service pump, used in connection with the control of the heating system, consists of one steam driven air compressor, made by the Union Steam Pump Co., the size being 4 by 3 by 5 in., the pressure carried being 16 lb. There is also one electric air compressor, the size of which is 4 by 4 in.

Fresh air furnished to the first and second floors and basements A and B is conditioned by Clarage air washers placed in a concrete housing located in the basement. There are four of these units. Steam is supplied for heating these by two 8-in. lines. In the entire building there are 34 fans, ranging in motor capacity from ½ to 30 hp.

In the office entrance, located over the doors, are three Johnson blowers which are heated by steam coils and furnish air for the lobby. Two blowers are also located over the bank entrance door.

Electric Services from Central Station

Electric current is furnished by the Philadelphia Electric Co., two separate feeders, coming to the building from two separate substations, a demand meter being supplied in each circuit. The voltage of these lines is 13,200, the service being 3-phase, 60-cycles. On each phase of these lines are overload relays of the time delay type and also no-voltage protection.

These lines are provided with a bus tie which throws in automatically in case one or the other of the lines fails. Each feeder has three transformer banks, one for lights, one for power and one for the elevators.

In normal operation, the load is divided equally between the feeders and there is a voltage regulator on each line. These are of the induction type rated at 288 kv-a., 3-phase, 13,200 v. and are self-cooled; the

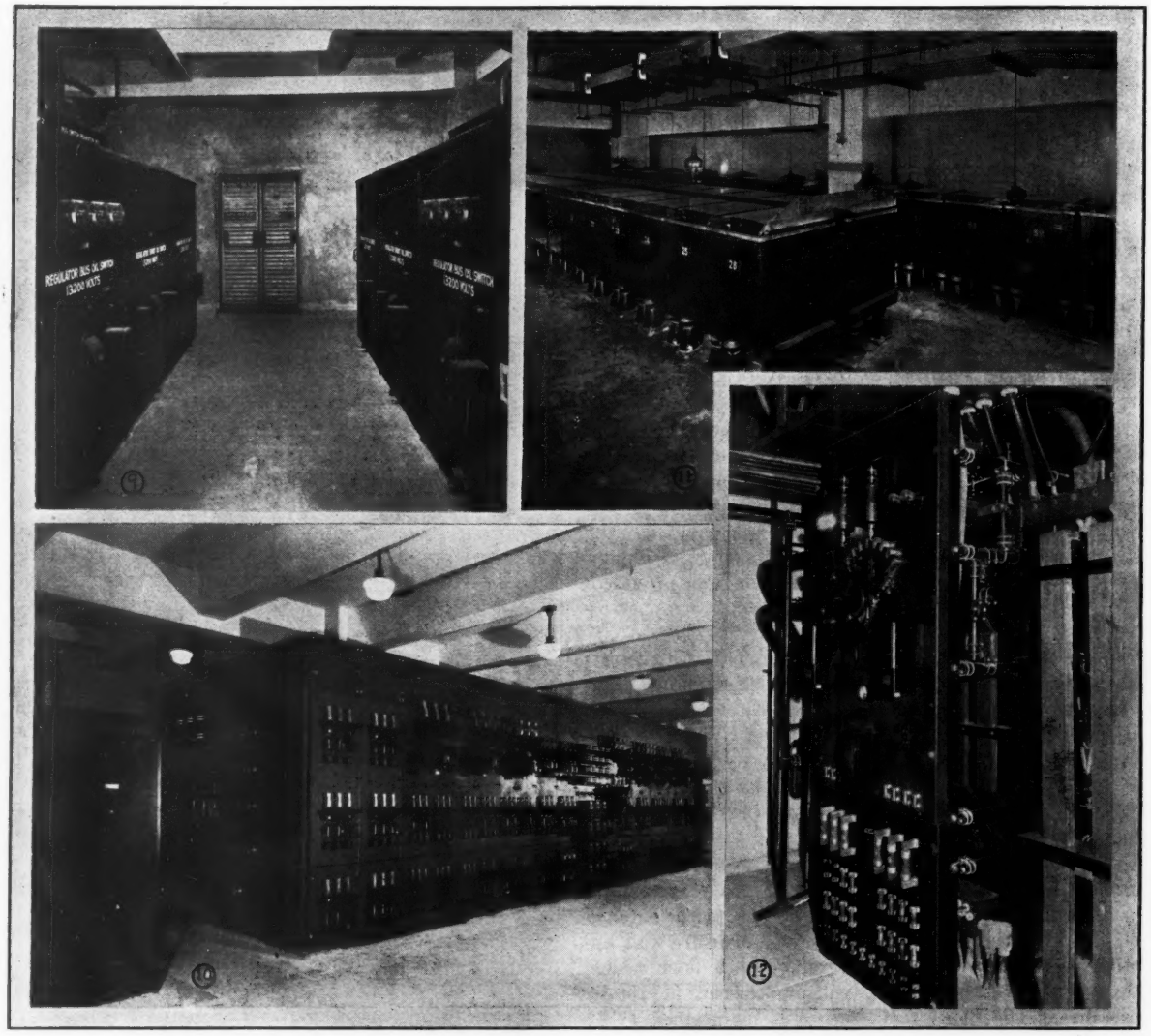


FIG. 9. HIGH VOLTAGE SWITCHES ON SUPPLY LINES. FIG. 10. VIEW OF MAIN SERVICE SWITCHBOARD. FIG. 11. STORAGE BATTERY SUPPLIES ALL REGULAR DIRECT CURRENT SERVICE AND EMERGENCY LIGHTING ONLY IN CASE OF TOTAL FAILURE OF THE POWER COMPANY'S SERVICES. FIG. 12. END CELL SWITCH FOR STORAGE BATTERY CONTROL

switching is done manually. Overload relays are on each line from the bus. An automatic tie is provided between the low-tension circuits, the same as on the high-tension side of the transformers. From each service the power and light load is divided in half. An emergency auto transformer, rated at 430 kv-a., 220 to 110 v., automatically connects the light to power or power to light load as the need requires.

Storage Battery Equipment

Direct current used about the building is furnished by an emergency battery consisting of 60 cells, in lead of charge. These end cells are connected by round lead plated copper in the battery room and a multiconductor cable outside the battery room, running to the switchboard room and connecting with a 100-amp., 9-point round pattern solenoid operated end cell switch also furnished by the Electric Storage Battery Co.

To operate the ratchet type switch, two solenoids provide for motion in either direction as desired, the arm moving one point at a time for each operation of a solenoid. Interlocking devices are provided so that when one solenoid is operating, the other cannot operate. The switch can be operated either manually, by

Mechanical and Electrical Equipment in the Fidelity-Philadelphia Building

GENERAL

Location of Plant.....Broad and Chestnut Sts., Philadelphia, Pa.
Owner..The Fidelity Building Corporation
Type of Plant.....Office building, heating and electric substation
Architects and engineers..Simon & Simon
Contractors.....Irwin & Leighton
Boiler capacity.....1609 hp.
Boiler feedwater obtained from city mains.
Boiler room located in Basement C.

BOILERS

5 water-tube, Casey-Hedges; two 185-hp.; three 413-hp.; 160 lb. pressure .....Combustion Engineering Corp.
Stokers—McClave hand-operated ..... McClave-Brooks Co.
Forced draft fan, G.E. motor drive... .....Clarage Fan Co.
5 draft gages, three-point type..... .....Bailey Meter Co.
5 CO_2 meters and stack temperature recorders, electric type..... .....Brown Instrument Co.
5 steam gages on boilers..... .....J. E. Lonergan Co.
Gage columns, high and low alarm.... .....Reliance Gauge Column Co.
5 feedwater regulators, Copes..... .....Northern Equipment Co
1 electric feedwater flow meter..... .....Brown Instrument Co.
Boiler draft control, Gray system..... .....Automatic Fuel Saving Co.
Blowoff valves....A. W. Cadman Mfg. Co.
Blowoff cocks, Everlasting..... .....Scully Steel & Iron Co.
5 Boiler stop and check valves..Elliott Co.
5 Safety valves.....J. E. Lonergan Co.
Soot Blowers.....Vulcan Soot Cleaner Co.
2 electric steam flow meters on heating system.....Brown Instrument Co.

COAL HANDLING

Electric storage battery industrial trucks, capacity ¾ t..Lakewood Engineering Co.
Platform scales....Fairbanks, Morse & Co.

PUMPS AND HEATERS

2 Boiler feed pumps, horizontal steam duplex, 10 by 6 by 12 in..... .....Warren Steam Pump Co.
5 injectors.....Penberthy Injector Co.
2 Sewage ejectors.....Ansonia Co.
2 Air compressors, motor driven, 256 cu. ft. per min., 100 lb. pressure... ..... Ingersoll-Rand Co.
2 Air compressors, steam driven, 40 lb. pressure..Westinghouse Trac. Brake Co.

SERVICE PUMPS

3 Air washer pumps, 490 g.p.m., 70 ft. head, single-stage, 15-hp. motor... ..... Dayton-Dowd Co.
1 7-hp. ditto .....Dayton-Dowd Co.
2 5th-fl. brine pumps, 100 g.p.m., 140 ft. head, single-stage, 10-hp. motor .....Warren Steam Pump Co.
2 28th-fl. brine pumps, 40 g.p.m., 60 ft. head, single-stage, 3-hp. motor..... .....Warren Steam Pump Co.
2 Ice water pumps, 20 g.p.m., single-stage, 2-hp. motor..... .....Westco Chippewa Pump Co.
1 Vacuum pump 250,000 sq. ft. rad., 15-hp. motor.....Skidmore Corp.
1 Vacuum pump, 250,000 sq. ft. rad., 14 by 20 by 24..... .....Warren Steam Pump Co.
2 Low-lift house pumps, 350 g.p.m., 282 ft. hd., horizontal steam recip., 12 by 8½ by 12..... .....Warren Steam Pump Co.
2 High-lift house pumps, 250 g.p.m., 425 ft. head, horizontal steam recip., 10 by 6 by 12..Warren Steam Pump Co.
1 Low-lift house pump, 350 g.p.m., 282 ft. head, 2-stage (Elec.), 50-hp.... .....Warren Steam Pump Co.
1 High-lift house pump, 250 g.p.m., 425 ft. head, 3-stage (Elec.), 50-hp. .....Warren Steam Pump Co.
1 Fire pump, 1000 g.p.m., 565 ft. head, 3-stage (Elec.), 200-hp..... .....Warren Steam Pump Co.
1 Hot water circ. pump (high zone), 50 g.p.m., 150 ft. head, 2-stage (Elec.), 5-hp..Warren Steam Pump Co.
1 Hot water circ. pump (middlezone), 50 g.p.m., 100 ft. head, single-stage (Elec.), 3-hp..Warren Steam Pump Co.
1 Hot water circ. pump (low zone), 50 g.p.m., 50 ft. head, single-stage (Elec.), 2-hp..Warren Steam Pump Co.
2 Sump pumps, 200 g.p.m., 50 ft. head, vertical, 3-hp.....Yeomans Bros. Co.
1 Feedwater heater, Webster open type .....Warren Webster & Co.
3 Water heaters....Whitlock Coil Pipe Co.
Water temperature regulators..... .....Fulton Sylphon Co.
3 Zeolite water softeners....Permutit Co.

MISCELLANEOUS EQUIPMENT

Pipe covering, steam, magnesia..... .....Philip Carey Mfg. Co.
Pipe covering, ice water and brine..... .....John L. Livsey
Piping.....National Tube Co.
Low Pressure steam and water fittings. .....Crane Co.
Steam traps.....Fisher Governor Co.
Vacuum traps on heating system..... .....Warren Webster & Co.
Reducing valves, steam and water..... .....Schade Valve Mfg. Co.
Valves, steam and water..... .....Fairbanks Co. .....Chapman Valve Mfg. Co. .....H. Belfield Co.
Pump Governors.....Fisher Governor Co.
Cylinder oil pumps...S. F. Bowser & Co.
Water meters, Trident..Neptune Meter Co.
Supply and exhaust ventilating fans, driven by General Electric Co. motors.....Clarage Fan Co.
2 ammonia compressors, automatic, 10-t. capacity, driven by 20-hp. General Electric motors.....Frick Co.
1 storage battery, 60 cell, type A-21, Manchester Box, 129-v..... .....Electric Storage Battery Co.
1 end cell switch, 100 amp., 9-point, solenoid operated..... .....Electric Storage Battery Co.
2 voltage regulators, induction type, 288 kv.a., 3-phase, 13,200-v..... .....General Electric Co.
1 autotransformer, 430-kv.a., 220 to 115-v.....General Electric Co.
6 transformers, 1-phase, 13,200 to 115-v., 250-kv.a....General Electric Co.
6 transformers, 1-phase, 13,200 to 230-v., 250-kv.a...General Electric Co.
6 transformers, 1-phase, 13,200 to 2300-v., 250 kv.a..General Electric Co.
12 transformers, 1-phase, 2300 to 230-v., 100-kv.a...General Electric Co.
4 capacitors, 60 kv.a., 2300-v..... .....General Electric Co.
All pump and fan motors furnished by .....General Electric Co.
Main switchboard and instruments.... .....General Electric Co.
Elevators and their auxiliary equipment furnished by...Otis Elevator Co.
4 air compressors, 100 cu. ft. per min., 95 lb., motor driven, supply air to elevator doors ....National Brake & Electric Co.
4 motors driving air compressors, 20-hp...Westinghouse Electric & Mfg. Co.
Enclose switches for pump motors.... .....Trumbull Electric Mfg. Co.
Control for service pumps..... .....Sundh Electric Co.
U-Re-Lite protective devices..... .....Cutter Mfg. Co.

lined tanks on oil insulation. The battery manufactured by the Electric Storage Battery Co. of Philadelphia, is installed in a room in the sub-basement near the vault of the Trust Co. Artificial ventilation is provided for the battery room.

This storage battery is arranged in four rows, one on each side of the room and a double row in the middle, connections between rows being made of lead plated copper. Sixteen of the cells are connected in eight groups of two, each, as end cells in order to provide for voltage regulation, as the voltage of the cells varies according to the load imposed and the state

means of an arm attached to the switch blade,—electrically, by switches actuating the solenoids,—or automatically, through a contact-making voltmeter, operating on the solenoids through relay switches. The contact-making voltmeter is set at the voltage which it is desired to maintain and, if the switch energizing the contact-making voltmeter circuits is in a closed position, the end cell switch is automatically kept on the proper cell to maintain the desired voltage.

In case of the failure of the building's normal supply, the battery is automatically connected to emergency circuits in the various basement rooms of the

building devoted to the operation of building facilities. It is also connected to emergency lighting circuits throughout the banking rooms, elevators, stairways and halls on all floors. In addition, the battery is used to furnish an uninterrupted current supply on the control buses, clock system, fire alarm and watchman circuits.

Charging the battery is accomplished by a trickle charger which supplies current slightly in excess of the constant load imposed by the circuits mentioned above. There are two of these units rated at 8½ amp. each. In addition, a booster of 20-kw. capacity is installed to be used in case a failure of the outside power supply has pulled down the battery charge.

Features of the Switchboard

Removable truck panels are used in the construction of the main switchboard and all the meters and switches on the switchboard are of General Electric Co. make. The switches on the main switchboard are operated from the storage battery with direct current.

Lighting and power circuits are open copper rods, run in wire shaft and are mounted on racks of slate insulators, the spacing being 4 in.

There are two telautographs in the bank operated by a motor generator, made by the Star Electric Motor Co., consisting of a 10-hp. a.c. motor at 220 v. and a 6-kw. 50-amp. generator at 120 v.

For charging the trucks a General Electric unit, rated at 51 amp., is used, delivering current at 31 v.

Throughout the entire building there is a signal system installed which is operated from the superintendent's office and consists of four colored lights, by means of which 15 different combinations can be signalled throughout the building to call different members of the organization.

Electric Service to Elevators

For elevator service, a 2300-v. feeder, consisting of a lead covered submarine cable runs from the transformers to the elevator substation, where truck switches, through a load responsive system, automatically take care of overload by cutting transformers in or out of service. The high-lift transformer substation for the elevators is located on the twenty-eighth floor. Here six single-phase transformers of General Electric Co. make are installed, each of 100 kv-a. capacity, voltage ratio being 2300 to 230, the arrangement of the transformers being two banks in parallel. The low-lift substation is a duplicate of that on the twenty-eighth floor and is located on the eighteenth floor. The transformers are self-cooled and are connected to temperature annunciators in the engineer's office. Each of the substations has two capacitors, rated at 60 kv-a. and operated at 2300 v.

Express elevator service consists of 10 passenger elevators, 800 ft. per min., 2500-lb. gearless traction type, signal control, serving the seventeenth to twenty-eighth floors, two having openings to every floor, eight in enclosed shafts, serving the seventeenth to twenty-eighth floors inclusive. There are 10 local passenger elevators, operating at 700 ft. per min., 2500-lb. gearless traction type, signal control, serving the first to the seventeenth floors. One service elevator operates at 600 ft. per min., gearless traction type, 4500 lb. capacity. One service elevator operates at 600 ft. per min., gearless traction type, 6000 lb. capacity. Six passenger elevators serving from basement B to fifth floor, 450 ft. per min., for banking quarters of the Fidelity-Philadelphia Trust Co., are equipped with self-leveling features. A sidewalk lift is operated by a plunger machine of the hydraulic type employing a motor operated Goulds hydraulic pump.

All the elevators in the building were manufactured by the Otis Elevator Co. The doors are pneumatically operated; the doors are solid so that the passengers are not bothered by the speed of the car as the elevator ascends or descends. The Otis signal system is installed, consisting of hall lanterns, waiting passenger signals and floor indicator signal in the car.

For each elevator there is provided a motor generator set, the elevators being operated by what is known as the unit multi-voltage system. This set consists of a 220-v. a.c. motor, connected to a 220-v. d.c. generator with individual 220-v. excitation. The elevators are of the direct traction type. There are two 110-v. d.c. motor-generator sets, consisting of a 220-v. a.c. motor connected to a 110-v. d.c. generator to furnish current for all elevator lights and signals.

Four air compressors are provided for operating the elevator doors and gates. These compressors were made by the National Brake & Electric Co., designed to compress 100 cu. ft. of air per minute to 95 lb. pressure and driven by Westinghouse 20-hp. motors. These air compressors are water-cooled and automatically controlled, the motors being of the slip ring type. U-Re-Lite overload protective device is provided and Cutler-Hammer starting switches are used.

In the preparation of this article, courtesies were extended C. Robert Cheyney, superintendent of the building, and great assistance was given by the engineering organization in charge of the building equipment. Simon & Simon, Architects, whose engineering staff designed the plant, also assisted by furnishing drawings and engineering data. To all of these we wish to express in this way our appreciation for their assistance and coöperation.

Recently, before the Montreal Section of Society of Chemical Industry, A. C. Fieldner, Chief Chemist of the Bureau of Mines, Washington, D. C., stated that coal was the most likely raw material source of gasoline substitute and that other sources, such as coal carbonization and oil-shale should be placed secondary to coal if and when needed.

Present and future processes for obtaining motor fuel from coal fall into three classes: coal carbonization, hydrogenation and liquefaction of coal by the Bergius process and the complete gasification of coal and conversion of the resulting gases by pressure synthesis into methanol, synthol and other liquid combustibles.

After detailed discussion of the various processes, he comes to the conclusion that the scientific commercial development of the conversion of coal to motor fuel exceeds the wildest dreams of chemists. The Leuna works of the I. G. has an installed annual capacity of 20,000 t. of methanol and 120,000 t. of crude oil. In the Ruhr district, another company has installed a 40,000-t. per annum plant for hydrogenating tars.

Power Plant Equipment for 1929

IN THE FUTURE, EQUIPMENT HERE DESCRIBED WILL BE USED BY PROGRESSIVE POWER PLANTS

FOR GENERATIONS, in all walks of life, it has been customary to pause on the threshold of the new year and look backward, reviewing briefly events which lead up to the present.

This desire for review may be due to egotism, to a sincere desire to be of service to those who follow or for encouragement. In retrospect, problems difficult or impossible of solution last year are revealed in their simplicity, offering encouragement and assistance in the attack on those problems that remain unsolved.

PRIME MOVERS OF ALL TYPES REACH HIGH STATE OF DEVELOPMENT

For approximately one hundred years, power plant engineering has been steadily advancing from the crude engines of Newcomb and Watts to the more modern Corliss, the uniflow and finally the turbine, which has been through its short commercial life of about 25 yr. sharing fuel economy honors with the newest of prime movers, the Diesel engine while competing successfully with the oldest and most efficient of all prime movers, the hydraulic turbine.

From oversized copper tea kettles operating at slightly higher than atmospheric pressure, the steam boiler has, through successive design and increased pressures reached the ultimate steam pressure of 3300 lb. From the totally enclosed and water cooled firebox of early internally fired boilers, the furnace has developed through periods of refractory linings, to an almost independent steam making unit of which the boiler as considered a short while ago, is but another method of reclaiming heat from the waste gases; like the economizer and preheater, a method of increasing the fuel economy.

From the comparatively recent period when a horsepower-hour was measured as 35 lb. of steam an hour, men now living and active in the industry have seen the water rate decrease to 30, 25 and 20 lb. per horsepower hour and, with higher pressures and superheats, the measure of economy change from pounds of steam per brake horsepower-hour to B.t.u. per kilowatt-hour. From 20,000 to 15,000 and 12,500 B.t.u. per kilowatt-hour is modern history, with engineers now considering 9000 to 8000 B.t.u. per kilowatt-hour as within the bounds of possibility.

PIONEERS IN HIGH PRESSURES DID NOT HAVE COÖPERATION OR SUPPORT

Lest, however, credit for modern practice be taken too seriously by the present generation, we should not forget the early work of Perkins, Stevens, De Laval and others who successfully pioneered high pressures but, because they were ahead of their time, without support of other branches of engineering, their efforts at the time were not appreciated or applied successfully.

Progress is a curious mixture of discovery, recurring cycles of progressive application and finally success through refinement of detail and coördination of related branches of engineering. Present power plant practice is made possible only by the combined efforts of chemical, metallurgical, electrical, mechanical and other branches of engineering. Few basic discoveries have been made in our industry by the present generation but the discoveries of the pioneers have been successfully applied.

PROGRESSIVE ENGINEERS LOOK FORWARD TO NEW IMPROVEMENTS

As our contribution to the industry, we have, in the December 15 issue, reviewed the past year's progress and development in central station and industrial plant design; in the January 1 issue, we have gathered together and presented all available data and material on one phase of power plant practice, fuel handling, and in this issue we are going one step farther; we are presenting a review of recently developed power plant equipment; equipment which will make power plant history during the coming year.

From the standpoint of the engineer, we are looking forward a year, giving him a glance into the future so that, if progressive, he can be in the forefront of those making power plant history next year rather than among those who wait until the end of the year to find out what the leaders have been doing.

Because of the wide variety of equipment in the power plant field and the activity recently displayed in developing new equipment it is impossible to cover the entire field each year. We have, therefore, selected from this broad field a few lines of equipment in which it was felt that the greatest progress had been made during the past year.

COMBUSTION, PRIME MOVER, ELECTRICAL AND AUXILIARY EQUIPMENT COVERED

Included in this list are furnace construction, combustion control, stokers, fuel and ash handling and feedwater system equipment, prime movers and their auxiliaries, refrigeration apparatus, air compressors, instruments, meters, motors, electrical switching and transmission line equipment.

Each piece of equipment has been developed to fill a specific need or meet an insistent demand. In order to make this review of maximum value to engineers, we have presented it in the form of statements, each manufacturer describing his own equipment in his own words, as he is the one most familiar with its design, features and possible applications. This issue is made possible only by the coöperation of manufacturers and we believe it will be of value to all power plant engineers, as well as, serve as an introduction to advanced power plant practice during 1929.

Manufacturers develop new Combustion Equipment *To give higher efficiency*

Developments in Furnace Construction

STATEMENT BY BERNITZ FURNACE APPLIANCE CO., BOSTON, MASS.

A DEVELOPMENT in water wall construction, known as the "Bernitz Co. Nygaard Water Wall," is the most important new offering in power plant equipment by the Bernitz Furnace Appliance Co.

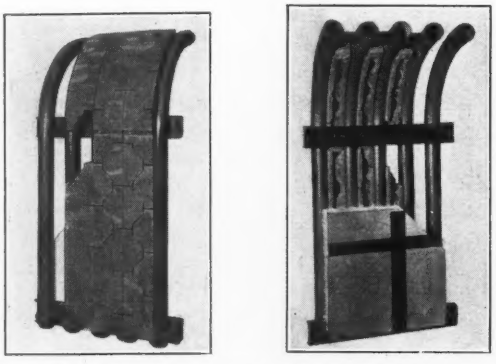


FIG. 1. SHOWING FURNACE SIDE AND OUTSIDE CONSTRUCTION OF BERNITZ CO. NYGAARD WATER WALL

For illustration purposes two photographs, Fig. 1, of a section of the Nygaard Water Wall are being enclosed. One of these shows the inside or fire face and the other the outside or rear face of the wall.

It will be observed that the blocks almost completely encircle the tubes. This has the effect of distributing the heat over nearly the whole surface area of the tubes and due to the excellent heat conducting capacity of Carbofrax, the rear part of the tubes are made to do more work. Also, vice versa, the larger the contact area between blocks and tubes, the more efficient cooling of the blocks.

Due to the angle on which the blocks rest on each other, a pressure is exerted which forces each and every block into intimate contact with and locks the blocks firmly to the tubes. The blocks are also interlocked with each other, so that no matter if the blocks are used in an arch or other position they cannot become detached from each other or the tubes during operation of the furnace.

Outstanding features of the Nygaard Water Wall are as follow: first, blocks are readily assembled and replaceable from the fire side without disturbing any construction or insulation in rear of the tubes, the blocks being sectionally supported and each section between the tubes being an independent unit; second, large contact area between blocks and tubes keeps temperature of blocks uniformly low by diffusing all absorbed heat to the entire circumference of tubes; third, unique interlocking arrangement and design of blocks provide for expansion, force blocks into intimate contact with the tubes, assuring high heat transfer, and eliminating auxiliary clamping devices; fourth, reduction of the weight on the tubes due to elimination of metal clamps

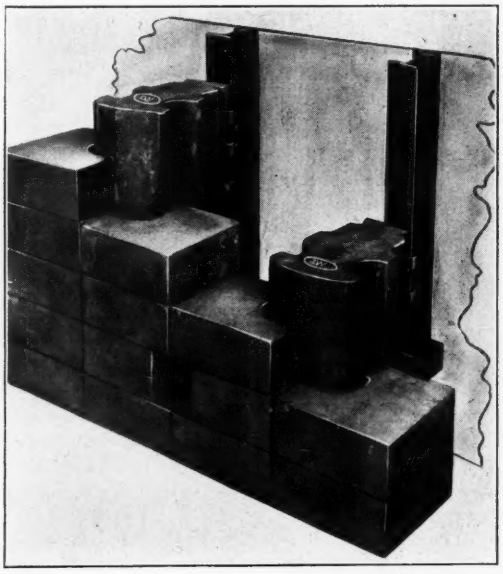


FIG. 2. DETAILS OF THE DeWOLF FURNACE CONSTRUCTION

for securing blocks to the tubes and also to the unique design of the blocks themselves; fifth, block equally adapted to bent tubes without resorting to special metal clamping devices. This results in a greater freedom of movement of the tubes at bends; sixth, flexibility of construction. Each block allowed a certain freedom to move with the tube to which it is fastened; seventh, block design reduces to minimum internal expansion stresses and effects economy of costly material without sacrifice of structural strength; eighth, Carbofrax, the Carborundum refractory, gives high heat transfer and durability to the blocks; provides excellent reflecting surface for radiant heat, together with sufficient heat storage capacity to insure complete combustion right up to fire face of wall and assures efficient operation at low as well as high ratings; ninth, operation with extremely high furnace temperature at 17 to 18 per cent

CO_2 without detrimental effect on walls; tenth, positive protection against tube failures and, eleventh, economy in first cost and maintenance.

STATEMENT BY THE DEWOLF FURNACE CORP., ROCHESTER, N. Y.

During the past year, the DeWolf Furnace Corp., was organized to engineer and sell the DeWolf Furnace. To provide a furnace wall that is flexible and resilient, rather than rigid and monolithic is the essential idea embodied in the design. The wall may be air-cooled or water-cooled or both and it has successfully met the severe conditions imposed by high capacity boilers operating at high percentage of rating.

Steel structure which forms the back-bone of the construction consists of standard steel I beams and angles. Flexibly attached to the vertical I beams are

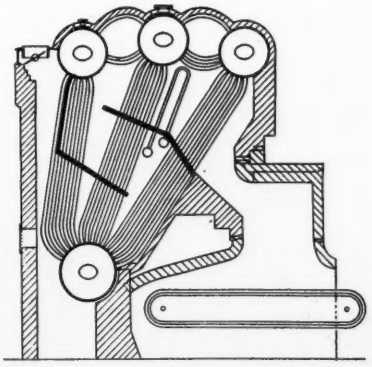


FIG. 3. APPLICATION OF THE ENCO CROSS BAFFLE TO A STIRLING BOILER

hanger bricks, which in turn hold in place four face bricks, this combination of one hanger brick and four face bricks constitute one unit of wall construction. The face bricks are exposed to the fire and take all the severe duty. Usual repairs call for the renewal of the face bricks only.

Provisions are made with the angles to sectionalize the wall horizontally, thus in making repairs to any section it is not necessary to disturb the sections above or below the one being repaired. The steel structure or the clamps are not imbedded in the refractories, with the result that the steel work is not subjected to any difficulty from heat. The same is true of the clamps.

Air ducts formed by the transite or other suitable material covering the steel work further cools the bricks and the steel work. The air used through the cooling ducts is then used as preheated air for drying the coal as pulverized, for combustion or both.

These bare tubes can be installed initially or at some later date when the steaming requirements may increase. The later installation is little higher in cost than it would have been had the tubes been installed initially. In this way, the steaming capacity of a given boiler can be very nearly doubled, at relatively little additional cost.

STATEMENT BY THE ENGINEER CO., NEW YORK, N. Y.

With the exception of the Enco Cross Baffles The Engineer Co. have not done a great deal of new development work during the past year. We are beginning to acquire a background in this particular work, however, and we have installed about 50,000 hp. An outstanding job is shown in the illustration, Fig. 3. This is a low set Stirling and by means of the cross baffles we have been able to design a back arch construction without either raising the boiler or lowering the grate. Tests made over a long period have shown that we can expect to produce a new horsepower from an old boiler at about ten dollars per horsepower and at 200 per cent of rating, we can expect efficiencies anywhere from 10 to 15 per cent above the single front arch construction.

This is the first installation ever made of this combination. Since then, three other installations have been made and while we are lacking complete test data, the general operating indications are that even better results will be secured.

STATEMENT BY THE FOSTER WHEELER CORP., NEW YORK, N. Y.

Three general classifications of furnace wall have been definitely established, as follows: air-cooled refractories, water-cooled metallic and steam-cooled metallic walls. These may be, and have been, used in a variety of combinations. The Foster Wheeler Corp. feel that the secret which controls their successes is still the perfection of the engineering determinations, as contrasted to any single design or construction.

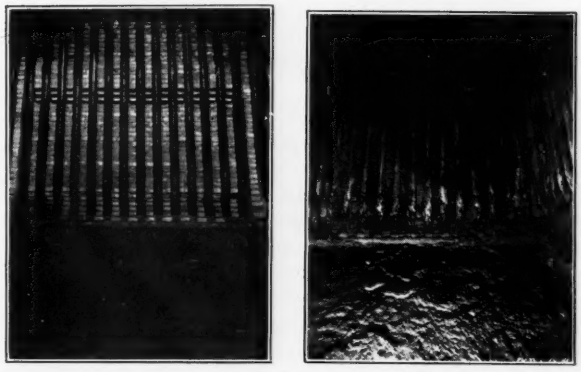


FIG. 4. A. FOSTER WHEELER BARE TUBE WALL SET ON MODERATE SPACING IN FRONT OF A REFRACTORY WALL. B. SAME WALL AFTER OPERATION

As an example of modern construction, three photographs are submitted. The first, Fig. 4A, shows a bare tube wall set on moderate spacing in front of a refractory, quite contrary to the preferences of many competent engineers, and, further, contrary to their recommendations based on difficulties with apparently similar constructions. The second photograph, Fig. 4B, shows this same wall after operation, it performed excellently, as contrasted to the many other bare tube walls that have suffered.

The third photograph, Fig. 5, is representative of the most fully protected water-cooled surface, steel tubes covered with cast-iron blocks shrunk on. This installation is a rear wall directly opposite to pulverized coal burners. It gives a flat, sloping surface having high heat absorbing capacity and virtually indestructible, either as to heat effect or damage from slag and firing tools.

Completely water and steam cooled furnaces are

quite common, but coöperation between the furnace engineer and the plant operators, in order to predetermine conditions exactly and to forecast future requirements, is the most vital factor of success. No known furnace construction can overcome faulty engineering.

STATEMENT BY FULLER LEHIGH CO., FULLERTON, PA.

Four boilers with Fuller Lehigh Co. Bailey furnaces similar to the one shown in Fig. 6 have been recently placed in service as part of the new 75,000-kw. extension to the Charles R. Huntley Station of the Buffalo

FIG. 5. RECENT CONSTRUCTION OF A FOSTER WHEELER FULLY PROTECTED WATER COOLED FURNACE SURFACE WITH CAST-IRON BLOCKS SHRUNK ON STEEL TUBES

General Electric Co., Buffalo, N. Y. These boiler units are each designed for maximum capacity of 300,000 lb. of steam per hour corresponding to 740 per cent rating. They have been operated successfully at rates of combustion as high as 43,000 b.t.u. per cu. ft. per hour or approximately 10 per cent in excess of the maximum designed capacity of the unit. Four other boilers at this plant had been equipped with furnaces of this general type prior to this installation and have been in operation since the latter part of 1926 and early 1927.

Coal used has a volatile content of 35 per cent and an ash fusing temperature of 1950 deg. F. The burners are set off the center line of each wall so that the flames impinge at right angles against each other and violent mixing results. The lower part of the furnace is designed for accumulating the ash in a molten condition and tapping it out intermittently in liquid form. While this method of ash removal is somewhat of an innovation yet experience with some furnaces during the past two years and with other furnaces that are now going into operation indicates that this is an ideal method of handling ash from pulverized coal fired furnaces.

The Fuller Lehigh Co. has equipped eleven boiler units now in operation with slag tap furnaces and in addition there are now fifteen units under construction. The following stations have been supplied or are being supplied with slag tap furnaces: Toronto Station, Ohio River Edison Co., Horseshoe Lake Station, Oklahoma Gas & Electric Co., Boiler No. 6, State Line Station, State Line Generating Co., 2nd Unit Powerton Station, Super Power Co., Deepwater Station, American Gas & Electric Co.

With horizontal turbulent burners in the lower part of the furnace, there is no difficulty in handling ash having a fusing temperature as high as 2500 or 2600 deg. F., in a satisfactory molten condition. With very high temperatures in the floor and the walls immediately surrounding the ash, combustion is completed in a minimum of space and an extremely high degree of turbulence can be had in this space with the flames impinging directly upon the floor without any fear of damage.

The upper part of the furnace can be so constructed that it can be cooled and thereby reduce the temperature of the gases before entering the boiler tubes. In other words, the combustion is completed in the lower part of the furnace and the height of the furnace from

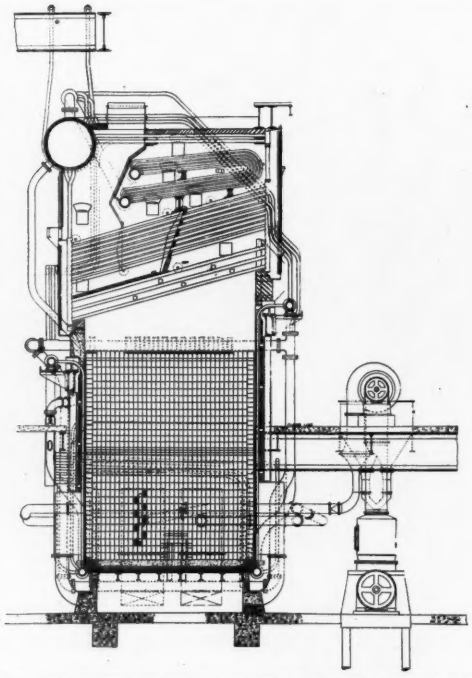


FIG. 6. BAILEY SLAG TAP FURNACE AS INSTALLED AT THE CHARLES R. HUNTLEY STATION

the floor to the tubes depends upon the percentage of volatile and other characteristics of the fuel which govern the distance required to complete combustion, and the distance required to cool the slag particles before reaching the boiler tubes. The particles of molten slag must be cooled either by radiation to the furnace walls or to the boiler tubes so as to reduce them below their fusing or sticky temperature before entering the boiler passes. Other advantages of this furnace are reduction in height of building and the use of a simple ash removal system. The ash is removed in a very satisfactory manner by means of a water jet with a minimum of labor and the boiler room is kept clean and free from dust.

STATEMENT BY THE GENERAL REFRACTORIES CO., PHILADELPHIA, PA.

Standard Silica Bonding Cement, a new product of the General Refractories, is recommended for laying up

fire clay and silica brick, patching and general repair work. It takes a strong air-set. It is suitable for use in furnace applications with working temperatures up to 2800 deg. F. and where the slagging action is not severe.

STATEMENT BY THE M. A. HOFFT CO., INDIANAPOLIS, IND.

The M. A. Hofft Co. have made no real changes in their wood waste stokers but have made a major change in automatic conveyors.

An installation typical of former practice had variable speed motors controlled by a Ruggles-Klingemann control device. It is possible to get closer regulation of the steam pressure by using the Reeves Variable Speed Transmission with the proper reduction gearing and a constant speed motor drive and then control the Reeves variable speed transmission by means of the Ruggles-Klingemann control. This is found to be more efficient and more satisfactory than the variable speed

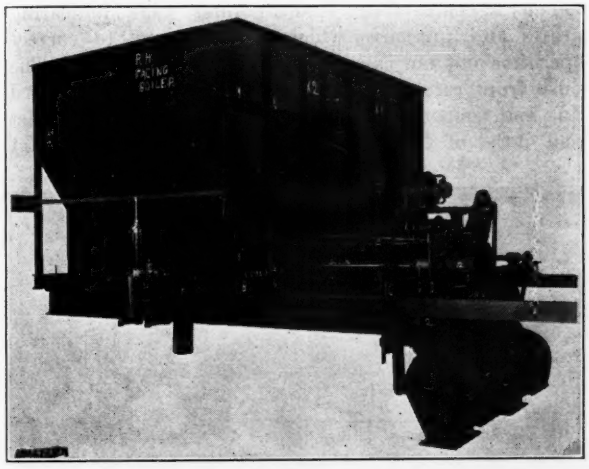


FIG. 7. WOOD WASTE STOKER AND FEEDER OF THE M. A. HOFFT CO.

motor to control the speed of the screw and the safety paddle wheel feeder. A new unit is shown in Fig. 7.

STATEMENT BY THE PLIBRICO JOINTLESS FIREBRICK CO., CHICAGO, ILL.

During the last year Plibrico, the product of the Plibrico Jointless Firebrick Co., has been used in a number of installations in connection with water walls. It has been used to replace the refractory tile which is ordinarily used in water wall installations. Used in this manner, it has a number of distinct advantages, the biggest of which is that, being plastic, it is adaptable to any tube diameter and any tube center.

STATEMENT BY THE LEAHY MFG. CO., LOS ANGELES, CAL.

In order to secure quick and complete combustion of oil and gas with a minimum of excess air, it is necessary to surround the combustible mixture with some incandescent material, and, wherever possible, it is desirable to support the combustion with pre-heated air.

A satisfactory fire can not be obtained in boilers until the combustion chamber has been first thoroughly heated. These important features are all a part of the new Leahy Pre-heated Air Furnace developed by the Leahy Mfg. Co. Each individual fire is completely surrounded by a refractory sleeve, and the furnace is provided with high temperature ignition walls which are so mounted that they may expand or contract under high heat without injury. The air being drawn in by the action of combustion is caused to circulate over and

TEST RESULTS FROM BOILERS WITH LEAHY FURNACES

Make of Boiler	STIRLING	STIRLING	B&W	B&W	RETURN TUBULAR	RETURN TUBULAR
Rating of Boiler, hp.	777.5	777.5	520	400	80	150
Kind of Fuel	Oil	Gas	Oil	Gas	Oil	Gas
Hp. Dev. per hr.	983	964	815	791	107.51	276.04
Per cent of Rating	127	124	157	198*	134.39	184.02
Draft Ins. Water	0.122	0.129	0.15	0.332	0.094	0.246
CO_2	13.6	10.4	13.6	10.9	13.8	11.10
O	3.2	2.4	2.6	2.2	2.8	1.77
CO	00.00	00.00	00.00	00.00	00.00	00.00
B.t.u. per lb.	18,650	1064	18,286	1107	18,810	1116.30
Efficiency, per cent	81.16	83.42	82.15	79.4*	81.51	80.53

*Note efficiency at 198% of rating. This efficiency was obtained and horsepower developed on approximately 0.6 cu.ft. of combustion area per horsepower.

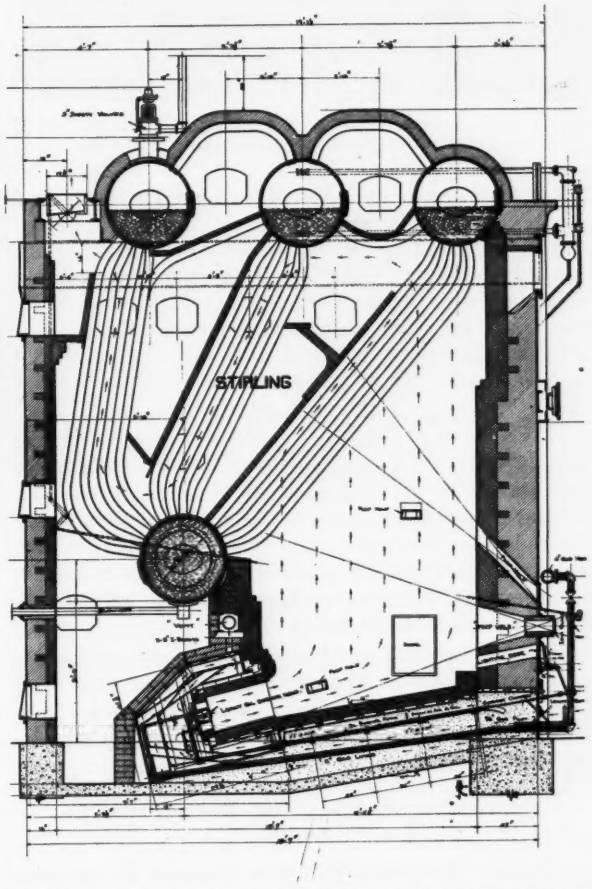


FIG. 8. IN THE LEAHY REAR FIRED FURNACE, FIRING IS CONTROLLED FROM THE FRONT AND BURNERS ARE SURROUNDED BY A REFRACTORY SLEEVE

under these high temperature ignition walls, thus materially aiding combustion and keeping all parts cooled down to the extent that they very seldom, if ever, need be replaced.

The special design Leahy gas burners used in connection with the Leahy Furnace are of the multi-jet type, which are adaptable to burn either high or low pressure gas. The oil burner is of the standard Leahy make, which has been used for many years, both in this country and abroad.

A distinctive feature of the Leahy Furnace is that it is equally efficient on oil or gas, and that either or both fuels may be used separately or together, without making any changes in the equipment.

Another factor of great importance is the direction of the flame with reference to the heating surface, or, in other words, the location of furnace and burners in the combustion chamber. The furnaces are designed for either front or rear firing, to meet the design of the boiler they are to be installed under. The rear fired furnace is controlled entirely from the front. Combustion is practically complete within the furnace itself, thus eliminating all harsh, ozidizing flames from coming in contact with the firebox refractories. Firebox maintenance is very low, due to this fact, as the furnace shortens and intensifies the flame, allowing only radiated heat to come in contact with the firebox walls and boiler tubes.

FIG. 9. FACE SIDE BARK AND ASSEMBLY VIEWS OF THE SEABOARD UNIVERSAL AIR COOLED BLOCK

Designed on the unit system, the Leahy Furnace uses as many units as are necessary to cover the entire practical width of the combustion chamber, thereby obtaining equal distribution of the gases. All units are controlled independently, and by means of draft door control to each unit it is possible to obtain maximum efficiency and overload capacity, and also have a furnace that is extremely flexible.

In both the front and rear fired furnaces, the burner control valves are in front, and complete burner control is maintained from this point. In some instances where boiler settings permit, the front fired furnace may be installed in the rear and controlled at that point.

STATEMENT BY THE SEABOARD REFRACTORIES CO., PERTH AMBOY, N. J.

During the current year, the Seaboard Refractories Co. has developed a special block, used for air-cooled side wall constructions, which is termed the "Universal Air-Cooled Block." This block is made in fire-clay, silicon carbide, (pure and a product containing varying percentages) mullite, sintered magnesia and sintered aluminum oxide.

The block is so designed that it may be installed in 9-in. walls and walls whose dimensions are multiples thereof and, unlike the other types of shapes designed for air-cooling, it can be used singly, thus not requiring the combination of two or more shapes. The block further provides for intimate contact between the air and the inner surface of the block, thereby effectively cooling the refractory and preventing the adhering of clinker with its attendant evils. The block is used in combination with a special corner shape of similar design.

New Combustion Control Equipment

STATEMENT BY BAILEY METER CO., CLEVELAND, O.

MODERN power plant practice requires that the operating guides and control equipment for each boiler be centralized on a neat appearing compact panel conveniently arranged so that the operator can grasp operating conditions instantly and if changes are required, make them without loss of time. Bailey Meter Co. equipment lends itself well to these requirements as illustrated in Fig. 1.

The panel shown in this photograph contains at the top a 12-compartment multi-pointer gage indicating drafts and pressures which are necessary to correct operation but not essential as a matter of record. The flush front recorders at either side of the panel record flue gas temperature and air temperature at the inlet and outlet of the two air preheaters. The recorder at the left of the twin flush front mounting in the center of the panel records and indicates steam flow from the boiler, records air flow and also superheated steam temperature at the outlet of No. 1 superheater. The meter at the right of the twin flush front mounting records and integrates feedwater flow, steam temperature at the outlet of No. 2 superheater and reheat steam temperature at the inlet and outlet of the reheaters.

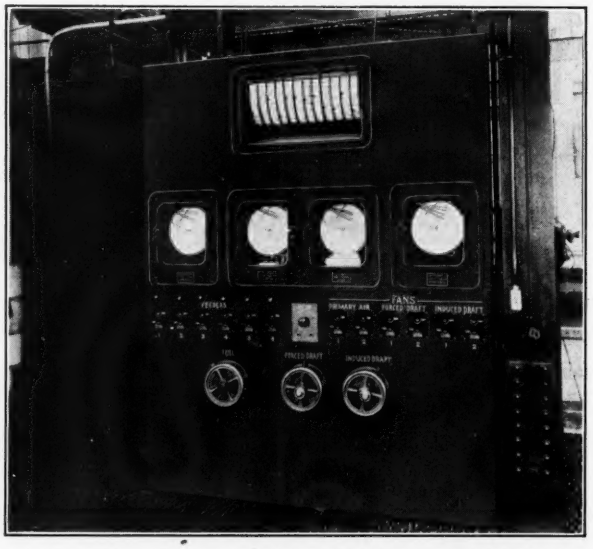


FIG. 1. LATEST BOILER CONTROL PANEL OF THE BAILEY METER CO.

Below the metering equipment are mounted the stop and start buttons for the feeder motors and fan motors, the automatic control system drum switch and the hand wheels for controlling the fuel, forced draft and induced draft manually, in case this procedure is necessary.

The drum switch at the center of the panel is de-

signed to permit push button control of induced draft, forced draft and fuel separately or together depending on the point to which it is turned. The final switch position connects the boiler to the automatic control system.

STATEMENT BY THE BRISTOL CO., WATERBURY, CONN.

An automatic air operated draft controller has been developed by the Bristol Co. This controller has a sensitivity of 0.01 in. of water, is available for either draft or pressure and is provided with an especially

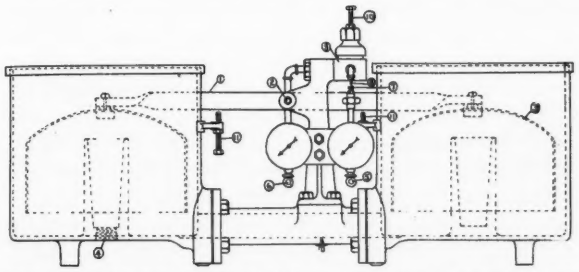


FIG. 2. SECTIONAL VIEW OF THE BRISTOL'S NEW DRAFT CONTROLLER

designed balanced air valve, air cylinder and piston attached to the damper.

STATEMENT BY THE BROOKE ENG. CO., PHILADELPHIA, PA.

Below is illustrated the new Brooke Eng. Co. Electrically Actuated Steam Pressure Regulator. This machine is normally used to operate a damper but can also be used to control the speed of fans, or as a very sensitive pressure reducing mechanism when connected to a properly designed valve. The regulator is made

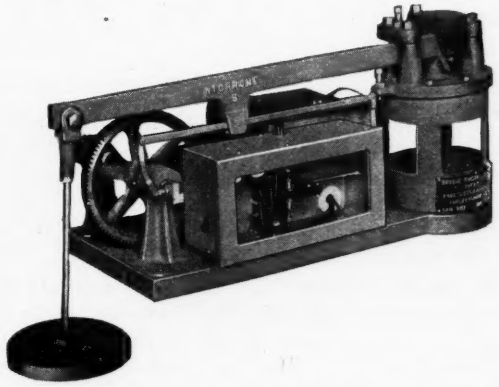


FIG. 3. ELECTRICALLY OPERATED DAMPER CONTROL OF THE BROOKE ENGRG. CO.

in two standard types, one to operate from 1 to 15 lb. pressure, and the other from 15 lb. up to 300 lb. or more. The low-pressure machine is guaranteed to move for a change in pressure of not to exceed ¼ lb., and the high-pressure machine for a change not to exceed ½ lb. Due to its construction, the machine will be just as sensitive after a year's operation as on the date of installation.

No water or compressed air is required, as power is furnished from a small Universal type electric motor. This motor is so small that it is connected directly to the nearest 110-v., a.c. or d.c. lighting circuit, but because of the high gear reduction between the motor and the operating arm (19,000 to 1) a pull of 150 lb. at the end of the 12-in. operating arm is guaranteed.

No relays are required, resulting in an extremely simple electric circuit. Although the contacts normally break less than ½ amp., they are $\frac{5}{16}$ in. diameter with silver tips. This type of contact has been used for 2 yr. continuous service and as yet no renewals have been necessary.

The machine is equipped with a very sensitive compensating device and also with limit stops to reduce the limit of travel of the operating arm if this should be necessary.

Virtually no maintenance is required. If the electric current to the regulator should fail, the regulator remains in its latest position until current is restored, at which time it will automatically seek the proper position.

Due to the fact that no water or air piping is required, the installation work is simple and the cost of installation is small. The motor is reversible, conse-

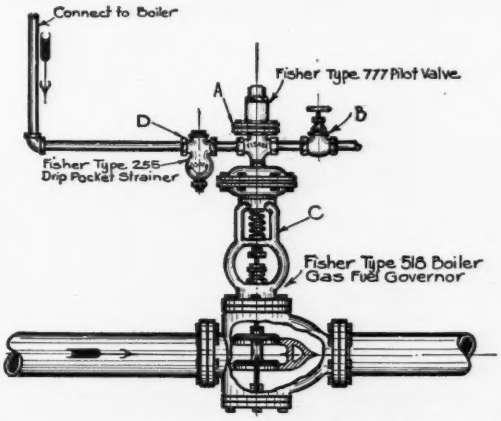


FIG. 4. NEW FISHER TYPE 519 BOILER GAS REGULATOR

quently equal power in both directions is obtained at the end of the operating arm; the machine can be mounted directly beneath or adjacent to the equipment to be controlled and a short rigid link connection made between the operating arm and such equipment.

In view of the fact that no pilot valves are used, we believe this machine to be more sensitive, more rugged, more reliable and to require less maintenance than any other machine now in use for a similar purpose.

STATEMENT BY THE FISHER GOVERNOR CO., MARSHALLTOWN, IA.

The Fisher Type 519 boiler gas fuel governor shown in Fig. 4 is a recent development of the Fisher Governor Co., which is being offered to the power plants who use gas as a boiler fuel. The 519 has several outstanding points which makes it extremely sensitive.

In the average installation where gas is used as fuel the gas pressure in the main leading to the burners is under low pressure. In order to get sensitive regulation, the valve body must offer the least amount of resistance that it is possible to obtain. With these conditions in mind, the Fisher Governor Co., designed the stream line valve body which is sectionally shown in the

accompanying cut. The stream line body has extremely large ports for the size of the valve and the stream contour of the inside of the body allows the gas to flow in its natural current and thereby eliminating eddies and back pressure pockets in the body. The pressure drop through this stream line body is practically negligible and it is, therefore, possible to obtain practically the full main gas pressure on the burners.

Type 519 is equipped with a sensitive pilot valve which is connected on the inlet side to a Fisher drip pocket strainer which in turn is connected to the boiler pressure. On the outlet side of the pilot valve is a small leak valve. The pilot valve has an adjusting spring on it to give a wide range of settings. The adjusting spring on the pilot valve is set at the point at which it is desired to hold the boiler pressure. As the boiler pressure reaches the desired point, it overcomes the tension in the pilot valve spring opening that valve, admitting a portion of the full boiler pressure to the

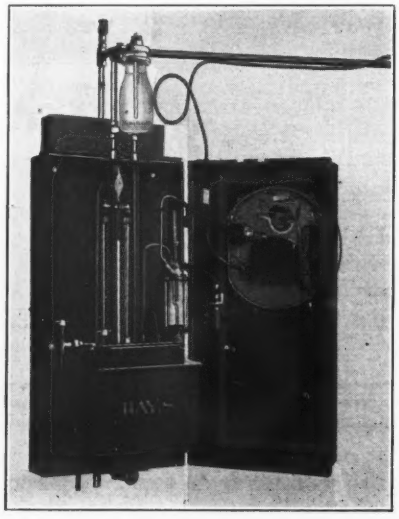


FIG. 5. THE HAYS COMBUSTION METER MODEL C

main diaphragm. The main diaphragm also is adjustable with the main adjusting spring. When pressure builds up on the main diaphragm, the inner valve is throttled, shutting down the flow of gas to the boiler, consequently lowering the flame under the boiler. As the boiler pressure lowers, the pilot valve closes and the leak valve allows the steam on the main diaphragm to escape, permitting the main valve to open.

STATEMENT OF THE HAGAN CORP., PITTSBURGH, PA.

During the year 1928, the Hagan Corp. has further developed its unit control system for power boilers, first announced at the 1927 Power Show. This system embodies; 1, a master panel at which variations in station steam pressures are converted to pneumatic sending pressure; 2, boiler panels, or stations at the individual boilers, by which these pressures are relayed in modified form to receiving regulators; 3, receiving regulators responsive to dampers and speeds of fans, stokers, or coal feeders. The utmost flexibility is incorporated in this system.

At the master panel, large load variations may, if desired, be anticipated and the ratings of all boilers correspondingly increased. The entire plant may be taken from automatic control and placed under manual control or, if desired, various groups of boilers may be thus manually controlled from this panel. At the boiler panels, the rating of the individual boiler may be increased or decreased from the average of the entire plant and each individual boiler may be placed under full manual control. The operating variables of each boiler may also be thus adjusted.

The Hagan Corp. has realized for some time that the modern large steam generating unit is economically adaptable to automatic control of an accuracy greater than that necessary in the past. This has not been true of the greater number of boilers constructed until recent years. Realizing further that in the final analysis the CO_2 content of the stack gases is the most reliable index of boiler economy available, the Hagan Corp. has developed and will shortly announce equipment for modification from CO_2 of the primary position regulation. In accordance with established custom, formal announcement will be withheld until the conclusion of exhaustive service trials.

This equipment will be characterized by ruggedness, sensitivity and accuracy. The best features of equipment for stack gas analysis developed up to the present time have been incorporated in simple means for modifying boiler regulation to maintain such percentages of CO_2 as are desired. By this equipment, stoppages of coal feeders, changing characteristics of boiler heating surfaces and resistances of tube banks, variations in stack draft, changes in coal characteristics, etc., as causes of changing boiler economy can all be substantially eliminated. The initial impulse from changing CO_2 will be obtained by actual analysis of the stack gases and not from differences in density or other secondary physical changes in stack gas properties accompanying changing composition.

STATEMENT BY THE HAYS CORP., MICHIGAN CITY, IND.

The Hays Corporation, Michigan City, Ind., announces its new combustion meter, Model "C." This highly refined machine can be furnished to record CO_2 in combination with either furnace draft or flue gas temperature or as a combined recorder for CO_2, draft and flue gas temperature.

In the new Model "C," the same accurate Orsat principle of operation which has characterized its predecessors is retained, the changes having been made in the recording rather than the analyzing parts. Suspended pens, a 10-in. circular chart and a new silhouette type aluminum chart case with polished aluminum door are features of the Model "C." Another feature is the draft attachment, the pen of which is actuated by the company's special slack leather diaphragm which has been used so successfully in Hays pointer type draft and pressure gages. The most sensitive range gives a pen movement of 2.5 in. with a draft of 0.2 in. water.

The introduction of the Hays panel of boiler room instruments has proven to be popular. This is a U-shaped panel of quarter-inch steel boiler plate with a metal enclosure for the top and hinged steel doors at the rear. The valves, pipes and wiring for the several instruments are conveniently accessible through these doors, yet they are protected and neatly concealed from

view. Slate fronts can be used rather than steel, if desired.

The aluminum case which encloses the recording parts of the Hays CO_2 recorder has been so designed that it may be flush mounted as shown, the analyzing parts being housed in a separate case at the rear. A companion recorder using the same type of aluminum case records steam pressure and temperature. The Hays pointer gage, with proper number of scales, for air pressure or furnace draft can be mounted either flush or semi-flush, depending upon the height above the floor. Any type of steam flow meter may be mounted.

STATEMENT BY RUGGLES-KLINGEMANN MFG. CO., SALEM, MASS.

An electrically operated power unit for remote control operation of boiler dampers has been developed

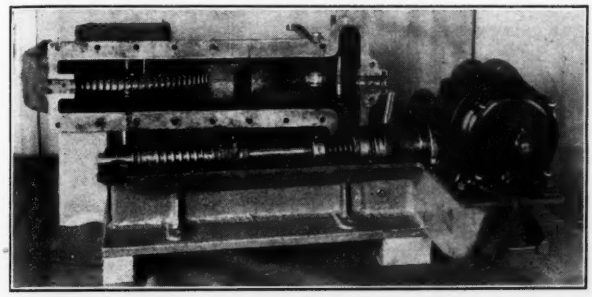


FIG. 6. THE RUGGLES-KLINGEMANN ELECTRICALLY OPERATED POWER UNIT FOR DAMPER CONTROL

by the Ruggles-Klingemann Mfg. Co. This unit, Fig. 6, is motor driven and is designed to be direct connected to damper shaft or to a line shaft connecting all dampers.

It provides for 90 deg. operation and is equipped with the necessary limit switches to prevent over-travel. A friction clutch is provided which protects the motor should the gear be operated beyond the limit switch positions, this clutch while transmitting the necessary power to operate several large dampers, yet will slip before reaching the point of the stalling torque of the motor.

The gear drive is through a double worm gear speed reduction, and several combinations of speed ratios can be supplied. This power unit is arranged for manual operation by means of a chain and sprocket wheel. By means of these power motors, boiler operations can be controlled from push button stations installed at convenient locations.

THIN SECTIONS of coal viewed by transmitted light under the microscope is the basis of a method of coal study now being made on American, English and German coals at the Pittsburgh Experiment Station of the United States Bureau of Mines. Since the degree of coalification or rank of the coal is in a measure determinded by the opacity of its thin sections, it is believed that the microscopic method of study will be a valuable aid in correlating the various coal classification schemes used by coal producing countries.

Stoker Improvements Cover All Sizes

STATEMENT BY THE ARMSTRONG MFG. CO., SPRINGFIELD, O.

THE NEW ARMSTRONG Automatic Stoker, illustrated in the accompanying photograph, has been designed and developed by The Armstrong Mfg. Co. to meet efficiently and economically every demand that may be placed on a stoker. It embodies a new and improved method of feeding the coal into the furnace where coking bars receive the fresh fuel and instantly start the process of combustion by distilling the gases from the fuel.

This stoker provides for progressive combustion of fuel, the elevation of the bars gradually carrying the fuel forward down over the stoker until, by the time the dump plate is reached, all combustible value of the coal has been burned. A combination of coking and interlocking bars insures complete distillation of the volatile gases, the sifting out of fine ash and the opening of all air spaces at all times.

To complete the process of combustion, preheated air is fed directly into the furnace from a special hot air chamber.

FIG. 1. AN INSTALLATION OF THE NEW ARMSTRONG AUTOMATIC STOKER IN A HOSPITAL

The stoker is driven by a small electric motor through a variable speed, clutch pulley which is instantly adjustable to any requirement. The hoppers are movable, thereby providing for easy entrance to the boiler tubes in certain types of boilers.

STATEMENT BY THE COMBUSTION ENGINEERING CORP., NEW YORK, N. Y.

Larger sizes of Multiple Retort Stokers have been entirely redesigned by the Combustion Eng. Corp. This new stoker is the outgrowth of many ideas and improvements which are the results of years of experience with this machine.

Practically the entire area of each retort is active underfeed area giving even fuel distribution over the entire grate surface. The strength and power of this

stoker are self-evident throughout the mechanism and its sturdiness is illustrated in Fig. 2. Parts subject to wear, such as ram box liners, lower section of ram, lower section of ram box and upper section of auxiliary rams, are easily renewable. Likewise, parts subject to burning, such as upper sections of retorts, tuyeres, side wall tuyeres and grate bars can be easily replaced.

Proportioned to the heavy construction of the main part of the stoker, the two speed gear box is machined throughout. The hand lever on the front of the gear box operates the clutches, by means of which the stoker

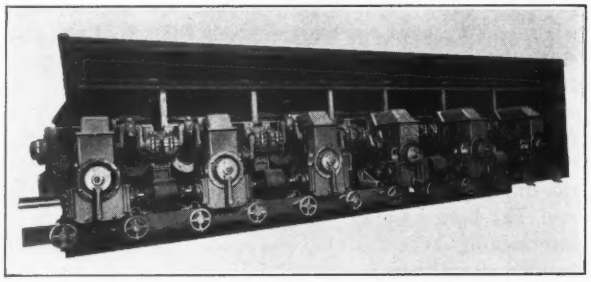


FIG. 2. FRONT VIEW OF COMBUSTION ENGINEERING CORP. NEW MULTIPLE RETORT STOKER

speed may be changed conveniently without stopping. The shear pin and coupling are conveniently located at the front of the gear box in sight of the operator.

Design of the ram box allows the depth of the retort to be proportioned to the length of the stoker. This is accomplished by adding tuyeres at the top of the retort instead of at the bottom as was formerly the practice. The advantages of this design are greater capacity per stroke, low, instead of high, crank shaft speed for high capacities, increased agitation of the fuel bed, more suitable time element for the combustion of the fuel, improved operation and efficiency.

The design of the auxiliary rams located in the retorts is a decided departure from former construction. There are several of these at intervals in the retort, the number depending on the length. They receive their motion from an oscillating link which is operated from a connection to the main ram. The stroke of these auxiliary rams is variable and separate adjustment may be made on each one. The amount of motion of all auxiliary rams may be changed simultaneously by means of a hand wheel at the front of the stoker.

Grate bars at the end of the stoker have a variable travel and move in sections. When the main ram is pushing coal into the furnace, the auxiliary rams are moving in the opposite direction and the section of grate bars is moving toward the ash pit. This action serves to agitate the fuel bed when the fresh charge is being forced in and distributes and levels the fuel bed, rather than forming the characteristic furrows usually existing in the fuel bed on an underfeed stoker.

Motion of the grate bars at the end of the stoker, being opposite to the direction of the auxiliary rams, serves to clear the ash from the end of the stoker, so as to be ready to receive the next increment of ash upon the change in direction of motion of the auxiliary rams.

Each retort is built up so as to provide for expansion and to minimize the possibility of cracking. The tuyere design gives stream-line flow of air and delivers the greater part of the air sidewise into the retort, which results in improved operation.

The ash pit may have either grinder rolls or dump grates. Dump grates are usually installed on the smaller sizes, while clinker grinders are standard for the larger sizes of stokers. These rolls are made up of semi-circular cast iron sections having replaceable teeth and fitted around a square steel shaft which is operated by a pawl and ratchet arrangement. Ordinarily two grinder rolls are furnished in the ash pit, both being reversible and having variable speed.

An installation at the Allegheny County Steam Heating Co. plant at 12th St., Pittsburgh, Pa., has three grinder rolls installed. This installation represents the first three-roll clinker grinder to be built by any company, the arrangement being such that one or both outside rolls can operate separately or in conjunc-

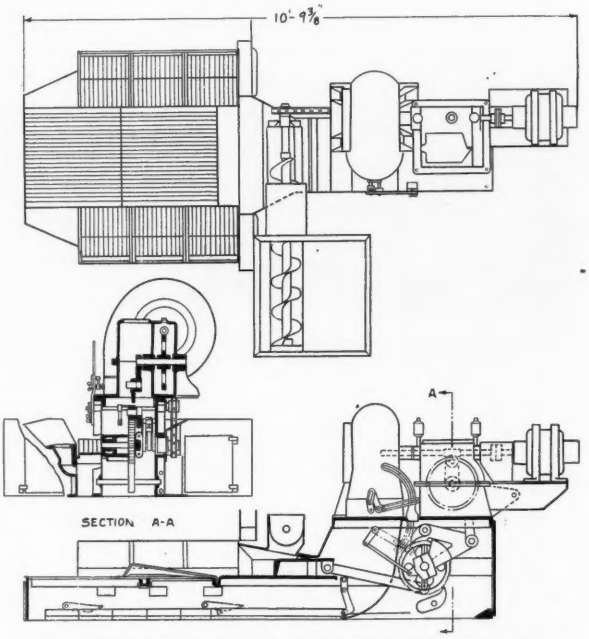


FIG. 3. DETAILS OF THE NEW HARRINGTON MODEL B STOKER

tion with the center roll which can operate in either direction.

The ram box, stoker driving mechanism, hopper and retort sides are bolted to the casting which supports the front wall. The entire stoker body subjected to heat is free to expand and cannot cause any disturbance of the front wall. Also in case of necessary replacement of any parts, the front wall does not have to be disturbed.

Zone control of air pressure is afforded by the use of separate air compartments extending across the width of the stoker. The amount of air pressure may be suited to the thickness of the fuel bed directly over any particular air compartment which, with intelligent operation, will result in the best combustion conditions. Without zone control, the air follows the path of least resistance and passes to the lower portion of the fuel bed where it is not needed, resulting in low CO_2 and high flue gas temperature.

Air may be admitted through tuyeres, grate bars, side wall tuyeres and either through dump grates or walls of grinder pit. The Multiple Retort Underfeed Stoker is recommended for burning all grades of coking bituminous coal and may be applied to the largest units as well as to those of medium and small sizes. Bituminous coals, having high ash content or low fusion temperature of ash, are more suitable to burn on chain grate stokers.

STATEMENT BY THE JOSEPH HARRINGTON CO., HARVEY, ILL.

Our Model "B" Stoker, designed by the Joseph Harrington Co., for fire-box boilers, cast iron sectional boilers and similar small heating boilers, is shown in Fig. 3. This stoker has a unique combination of an underfeed method of introducing the fuel, combined with progressive combustion, a horizontal travel of the fuel bed and a continuous and automatic discharge of the ash as formed at the rear of the furnace.

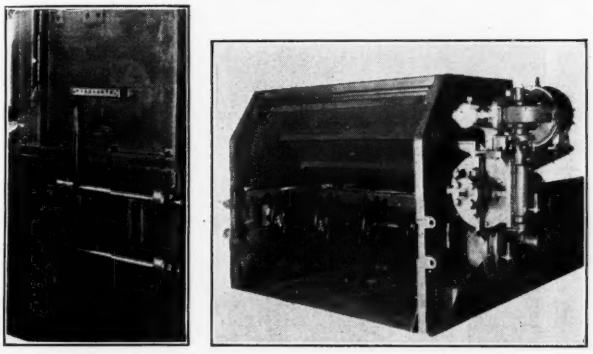


FIG. 4. A. TAKE-UP INDICATOR AND B. NEW STOKER DRIVE NOW USED BY ILLINOIS STOKER CO. ON THEIR FORCED DRAFT STOKERS

The underfeed system of pushing the coal in under the incandescent layer of fuel insures smokelessness and a substantial body of fuel which holds the heat well between periods of activity. It differs sharply from the underfeed stoker, however, in that there is a movable section of grate surface in the bottom of the trough which forms the grate surface. The motion of this grate section causes the fuel bed to move along gradually towards the rear as it undergoes combustion.

Area of fixed carbon combustion is above in the center of the fuel bed just as it is in the other stokers and towards the rear the fuel bed is caused to flow over a section of the grate surface wherein the air space is much restricted. This presents a strong contrast to the underfeed stoker in that the fuel is constantly removed and not allowed to accumulate in and upon the fuel bed.

The stoker is made in two sizes, burning from 25 or 50 lb. up to 500 or 600 lb. of Illinois Bituminous Coal per hour. It will also handle an Eastern coking coal with great success and excellent efficiencies are obtainable with either.

Equipped with fully automatic control, the stoker is regulated by the steam pressure. Both coal and air are independently regulated. It is operated from any standard motor and was designed in all its details with the intent to make it conform in all respects to the highest standards of stoker engineering.

STATEMENT BY THE ILLINOIS STOKER CO., ALTON, ILL.

During the past year, the Illinois Stoker Co. has designed and applied to its forced draft stokers a take-up indicator for the purpose of checking the alinement of the front drive shaft. Referring to Fig. 4A, it will be seen that this feature consists of cast iron pointers bolted to the front shaft bearing, this construction being applied to both sides of the stoker. With this new feature, it is easy for the operator to make sure at all times that the front drive shaft is properly lined up.

This company has developed a new drive for its forced draft chain grate stokers as is shown in Fig. 4B. It will be seen that this drive consists of three worm and gear reductions mounted in series and driven by a direct connected motor having a wide speed range. The entire drive is integral with the front drive shaft of the stoker and moves forward or backward as the chain take-up bolts are adjusted. There are no moving parts exposed on this new drive, which provides a much longer life for the equipment as compared with drives requiring exposed moving parts, especially in view of the dirty conditions that usually exist in boiler rooms.

A new system of cooling stoker chains, especially

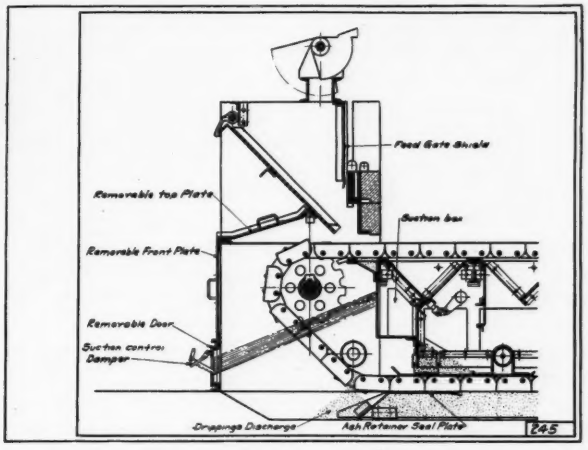


FIG. 5. STOKER CHAIN COOLING FEATURE OF THE ILLINOIS STOKER CO.

where preheated air is encountered, was recently developed. This construction is shown in Fig. 5 from which it will be seen that a suction box is installed immediately back of the front drive sprockets. The front vertical face of this box is provided with a series of holes through which boiler room air is drawn from the adjacent opening in the stoker front casing, as shown. This cross duct is connected either to an individual fan or to the boiler breeching. The operation of this feature is such that boiler room air is drawn through openings in the stoker front casing, through the chain, and into the suction box through the holes provided therein. The amount of air drawn through the chain for cooling purposes can be varied depending upon the amount of preheat and the per cent of rating.

It will be seen that this feature not only allows the stoker chains to be kept cool at all times, but allows the stoker to be successfully adapted to plants where waste

gases are available. It also provides a clean boiler room so far as the stokers themselves are concerned.

STATEMENT BY THE OIL CITY BOILER WORKS, OIL CITY, PA.

Known as the Oil City Stoker Unit Return Tubular Fire Box Boiler, a new unit has been developed by the Oil City Boiler Works and at present is being used extensively on school work and office buildings. In Michigan at this time, mostly in Detroit, the company has about 35 jobs with this new boiler and also has these boilers installed in Atlanta, Ga. schools, North Carolina State College, McDonald, Pa. schools and a number of others.

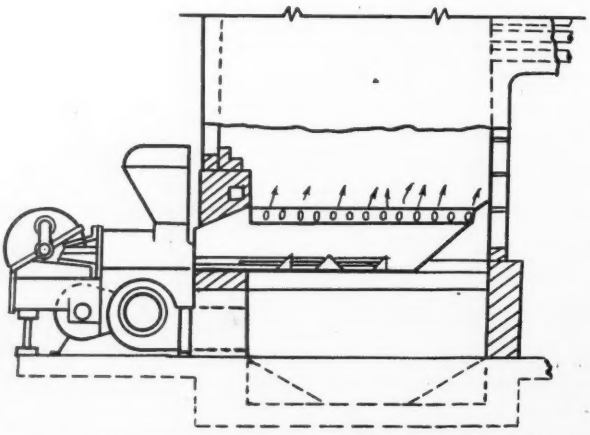


FIG. 6. OIL CITY STOKERUNIT FOR HEATING PLANTS

Some of the features of this boiler are as follows: Built in sizes from 75 hp. to 300 hp. inclusive for pressures ranging from 15 to 125 lb.; it is a self-contained unit with the stoker inside the water-walls of the boiler, thereby eliminating the use of refractory settings; the fire is entirely surrounded by water-walls.

Distance between the tuyeres of the grate and crown sheet is 6 ft., giving a large combustion area. Furthermore, the ratios of the tubes are such that at 150 per cent of rating the stack temperatures do not exceed 650 deg. and at 100 per cent of rating the stack temperature tests showed 430 deg. An eight-hour test made by disinterested engineers showed an efficiency of 81.4 per cent.

STATEMENT BY THE WESTINGHOUSE ELEC. & MFG. CO., E. PITTSBURGH, PA.

Boilers of today are higher and narrower than their predecessors. The use of comparatively narrow boilers naturally necessitates the use of very long stokers to obtain the required coal burning area within the restricted furnace width. But the long retort, in itself, is not sufficient. Simply burning coal is one thing; burning it efficiently with low stoker maintenance is quite a different problem. This problem has been solved by a revolutionary design involving a seemingly radical combination of overfeed and underfeed sections. The principle of the overfeed section as used, is somewhat similar to the grate construction of the single retort underfeed stoker. A stoker has been offered by the Westinghouse Elec. & Mfg. Co. for a single boiler unit to produce 45,000 kw. normally or 60,000 kw. for short periods.

In conjunction with high capacity clinker grinder stokers there has been developed a water-cooled, refractory lined grinder pit which is practically immune from the destructive action of the fire, assuring greater continuity of service with reduced maintenance.

The line of single retort stokers has been augmented by a longer stoker for greater capacities with the same width boilers and by a narrower stoker for application to smaller boilers, particularly of the return tubular type.

The slowly turning crank of a single retort stoker is a "shock load" to the driving mechanism. Worm gears, commonly used for high speed reductions, are not entirely satisfactory and a triple reduction gear-unit, using a combination of spur and helical gearing, with tapered roller bearings and splash lubrication throughout has been applied to give a compact, rugged and 96 per cent efficient drive.

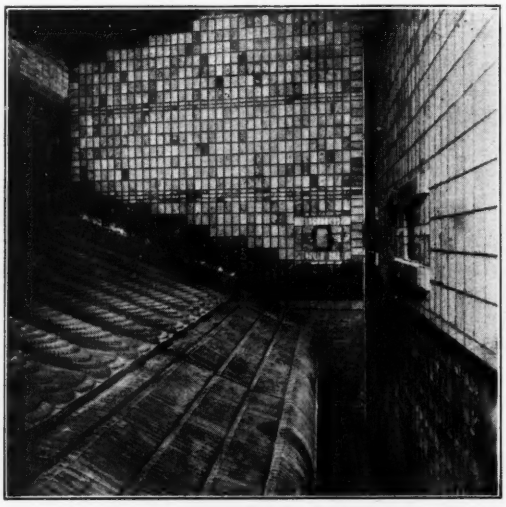


FIG. 7. WESTINGHOUSE MULTIPLE RETORT UNDERFEED STOKER WITH UNDULATING LINK GRATE OVERFEED SECTION

Electric motors are usually limited to a 4 to 1 speed range, but present day boiler service demands twice that adjustment for the rate of stoker feed. For this reason, the new unit has selective two speed transmission. An automobile type multiple disc clutch permits easy shifting of gears. With the driving motor running at 1000 r.p.m., the gear box turns the stoker cranks 13 or 7 r.p.m., as desired.

DEPARTMENT OF COMMERCE announces that, according to data collected at the biennial census of manufactures taken in 1928, the establishments engaged in the manufacture of electric generators, transformers, motors, and electric fans in 1927 reported these products, together with parts and supplies, to the value of $312,576,294, an increase of 4.9 per cent as compared with $298,010,383 for 1925, the last preceding census year.

A HANDFUL of good life is worth a bushel of learning.—Geo. Herbert.

Plate Type Preheaters Improved

STATEMENT BY THE COMBUSTION ENG. CORP., NEW YORK, N. Y.

IN RESPECT to thermal performance and lack of operating troubles, the most effective arrangement of air path through the heater has been found to be what is known as the "S" flow, shown in Fig. 1, illustrating the C. E. Air Preheater of the Combustion Engineering Corp.

In this design the flue gas flows directly up or down through the heater and the air flows in the opposite direction in an S shaped path, which provides approximately equal length for all air lanes, gives more uniform flow and a more uniform heat transfer rate across the heater.

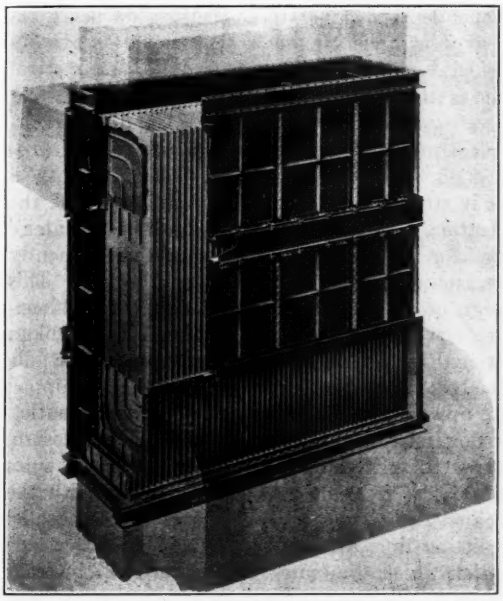


FIG. 1. COMBUSTION ENGINEERING CORP. LATE "S" TYPE PREHEATER

The latest design provides sectional cleanout doors across the entire heater for the insertion of steam or air lanes, which makes it possible to clean the heater during operation. A further improvement has been made by welding the elements to sealing strips at the air inlet and outlet instead of using bolts. This eliminates the possibility of leakage at these points. The elements themselves are electrically welded, as usual.

STATEMENT BY THE FOSTER WHEELER CORP., NEW YORK, N. Y.

The Foster Sectional Air Heater (Haber Patents) was introduced to power plant engineers in its present form during the past year by the Foster Wheeler Corp. This air heater is peculiar from any other offered in this country due to its constructional arrangement. It is built and shipped from the works in completed sections, each containing a large amount of heating surface and ready for service after merely bolting into place.

Figure 2A shows a typical section of a Foster air heater with plates cut away to show the positive spacing arrangement, the corrugated metal ribbons for defining the air and gas passages, the through bolts and the corner construction which provides a tight joint while allowing for expansion of plates without buckling. From this drawing, it will be seen that all of the heating surface is made effective and that short circuiting is prevented.

An example of one arrangement of air heater sections,—grouped four high, is shown in Fig. 2B. Any number of such groups, for instance, can be placed parallel to one another. In this installation, gases enter at the top and flow straight down through all four sections. Air, on the other hand, enters at the right of the lowest section, flows horizontally through it, then upward in a connecting casing to the section next above and horizontally again through this second section. The process of heating in stages is thus continued until the air, fully heated leaves the uppermost section. This arrangement gives a cross, counter current flow that effects high heat transfer.

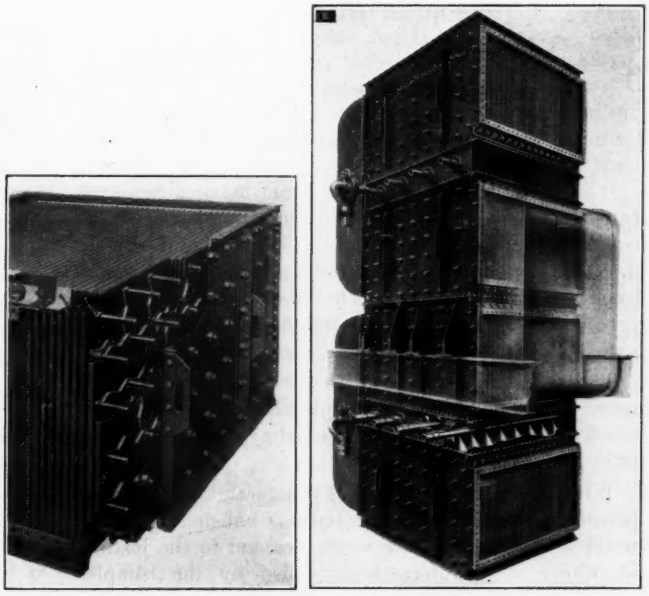


FIG. 2. A. CUTAWAY SECTION OF FOSTER SECTIONAL AIR PREHEATER. B. ARRANGEMENT OF THE HEATER WITH FOUR SECTIONS

Effective soot blowing is one of the most important features relating to air heater operation. A dirty air heater is rarely a profitable investment. The soot blowing in Foster air heaters is accomplished by steam or air blowers so designed that in addition to a rotary movement of the jets, the element itself may be moved longitudinally. This makes it possible to place soot blowers between each pair of sections and blow the sheets above and below each jet by rotation.

After blowing in one position, the element carrying the jets is moved lengthwise a distance equal to the space from the center of one gas passage to the center of the next and rotary blowing repeated. In this way a very simple soot blower covers the entire gas passage surface. The corrugated strips, which divide the gas passages into lanes, restrict expansion of the steam so

that high velocity is maintained across the surface to be cleaned.

Under certain conditions of operation, the cold end of air heaters has a tendency to corrode. In the design shown in Fig. 2B, the lowest section constitutes the cold end. For this reason, the air heater is supported from the next section above and should the lowest section rust out, it can be quickly and cheaply replaced by unbolting from the section above and dropping out of place.

Coal and Ash Handling Developments Active

STATEMENT BY THE R. H. BEAUMONT CO., PHILADELPHIA, PA.

SPECIALLY DESIGNED for heavy, continuous service under severe operating conditions, a new winding machine is the latest product of the R. H. Beaumont Co.'s many years' experience in building skip hoists.

It is the spur gear type, the drum being direct connected to the motor by a train of cut spur gears, which are fully enclosed by a cast-iron housing and run in oil. This type was adopted only after years of experience with other types. The direct connected spur gear hoist was designed to eliminate thrust bearings, loss of power through friction, excessive and rapid wear.

The machine is fitted with a shoe type magnetic brake, complete controlling equipment and slack cable switch. The entire operation of the machine is automatic and foolproof.

With full automatic, full magnetic control, the operator pushes a starting button, causing the skip bucket to ascend, dump, reverse, descend to the loading pit, where it is automatically filled by the Simplex Loader and again ascends, continuing through this cycle until the "stop" button is pushed.

With semi-automatic, full magnetic control, as generally used for ash handling service, the bucket will come to rest in the pit automatically at the end of each trip.

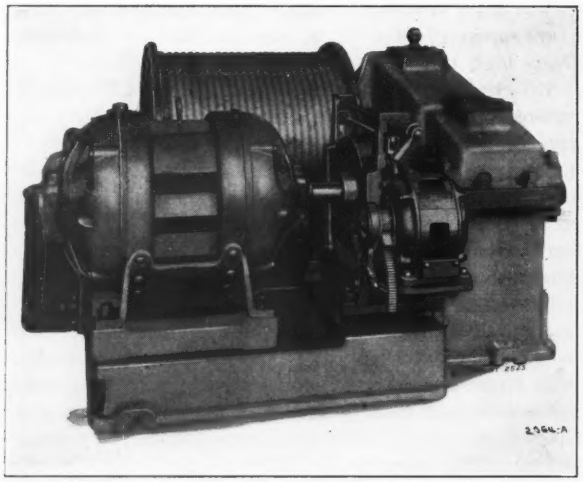


FIG. 1. BEAUMONT SKIP HOIST WINDING MACHINE

When both coal and ashes are handled by the same skip hoist, these two types of control are combined, so that coal may be handled continuously and ash intermittently.

STATEMENT BY THE HAHN ENG. CO., PHILADELPHIA, PA.

Cast-iron tanks and bunkers developed by the Hahn Eng. Co. are made up of 24 by 24 in. sections. Even though of cast iron, the thickness of the sections, being only from $\frac{5}{16}$ in. to $\frac{3}{8}$ in., is hardly any greater than that of the corresponding steel plate. This is possible because the structural steel members forming the frame work for the cast iron sections are only 2 ft. apart vertically, so that the castings are not expected to carry any excessive loads by themselves. This design also permits the convenient removal of the component sections independently. Since these sections do not overlap, but abut at their flanges, the removal is readily accomplished by disconnecting four bolts per section, so that the matter of possible repair becomes simple and inexpensive as against patching up steel plate units.

A typical unit is an octagonal tank for bottom discharge, which, in addition, is also equipped with a thawing-out steam chamber as an integral part of the hopper bottom. Furthermore an "upward agitator" is provided for the purpose of disturbing the frequently occurring arching in the tapered hopper bottom. This basic design of an octagon is modified into an oblong-octagon to serve as a continuous overhead coal bunker, as shown in Fig. 2. There is no opportunity for idle coal in the bottom of this bunker, which is also equipped with an "upward agitator" over each tapering outlet.

A further modification is the semi-octagonal design, derived from a split octagon across two opposite sides and most logical for side-discharge design. With the outlet located in the side of the octagon that is parallel to the splitting line, a taper is provided on either side of the outlet, which eliminates "waste corners" in front

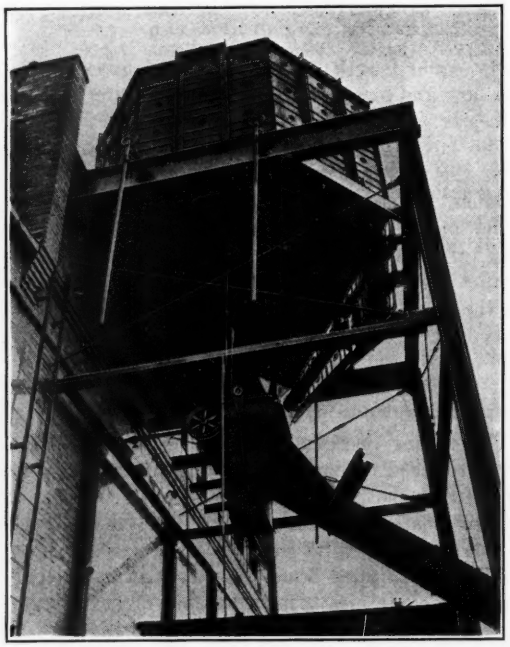


FIG. 2. HAHN CAST-IRON SECTIONAL BUNKER

of the tank. Thawing-out steam chamber, agitators and also access-doors are provided in this design also.

These tanks and bunkers offer the following distinctive advantages: 1, being constructed of non-machined cast-iron sections, they are impervious to corrosion and abrasion and are therefore practically indestructible; 2, can be erected or dismantled readily even without previous experience; 3, their design is correct from the viewpoint of "discharge efficiency" even when the material stored is wet or frozen.

Statement by the George Haiss Mfg. Co., New York, N. Y.

Improvements have been incorporated by the George Haiss Mfg. Co. in the Portable Belt Conveyors and Clam Shell Buckets. The rollers which have always been equipped with ball bearings now have larger size of ball and instead of the grease being packed in the roller, the tube shaft is equipped with Alemite Zerk system of lubrication. A new tail bearing has been designed equipped with Hyatt roller bearings and a felt washer placed outside of the bearing to prevent sand and grit from getting in.

Wheels on the smaller sizes of belt conveyors are now equipped with roller bearings for ease in moving them. A new style raising device has been designed to allow greater latitude in the angle of movement and allow the belt to lie more nearly horizontal when it is desired to convey material and not raise it. A stronger and heavier belt is used on the conveyor.

The three types of Haiss clam shell buckets, that is the "Hi-Power" sheave type, the "Lever Arm" and the "Contractor" closing wheel type, are all equipped with new head pieces so arranged that there is no side sway in the four connecting rods. The steel brackets which are attached to the top of the bowl and to which the connecting rods from the head are inserted are redesigned and so arranged that the lugs extend beyond the back of the bowl approximately 4 in., giving a greater leverage when the buckets are being closed. These brackets are all cast steel and materially increase the stiffness of the back of the bowl.

Statement by the Holly Pneumatic Systems, Inc., New York, N. Y.

Recently the Holly Pneumatic Systems, Inc., adapted the automatic equipment for power plant service. Both the Philadelphia Electric Co. Delaware Station and the New York Edison Co. East River Station are using this equipment for the removal and recovery of coal dust and spilled coal throughout the mill and boiler houses. The equipment is exactly similar to the large installation built for unloading freight cars.

In a power plant, the amount of dust, particularly in those using pulverized fuel, is so great that the ordinary vacuum cleaning systems will not take care of the requirements. Holly machines are high duty and high vacuum units providing for the constant discharge of the material as fast as it is collected and for the automatic cleaning of the filter bags every three minutes. In both installations mentioned above, the material is returned to the coal bunkers.

Statement by H. P. Rodgers & Co., Cleveland, O.

H. P. Rodgers & Co. has brought out a steam jet

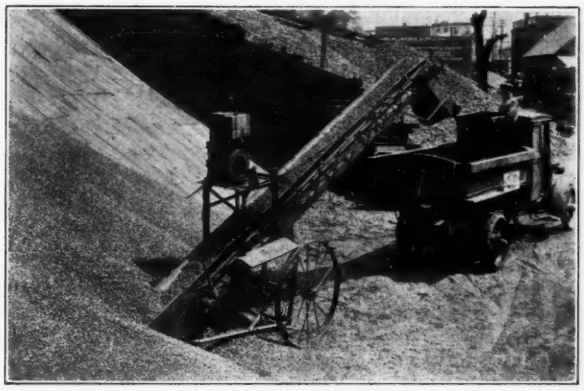


FIG. 3. IMPROVED TYPE HAISS PORTABLE BELT CONVEYOR

conveyor of its own manufacture and design. Outstanding features are: efficiency; simplicity; convenience for making repairs and minimum waste of unused metal.

The 90-deg. steam jet elbow is made in three principal parts, consisting of main body, back and steam nozzle plate. The back of the fitting is of heavy construction to withstand the abrasive action of the ash for a long period of time and when it becomes necessary to replace it, no other part of the fitting need be disturbed; it is necessary only to loosen four bolts, withdraw the back from the assembly, slip a new one into place, bolt up and proceed with operation. The nozzle plate at the bottom of the fitting is a gray iron

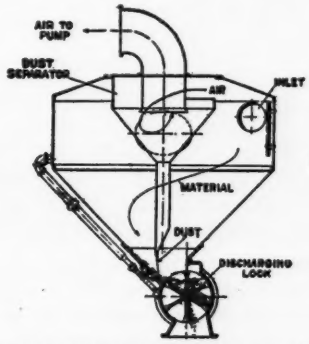


FIG. 4. DIAGRAM OF THE RECIPIENT-DISCHARGE SYSTEM OF A HOLLY VACUUM TYPE CONVEYOR

circular self-centering plate fitting into a recess cast into both main body and back. The nozzle header consists of a tee with an upper male union end which screws into the nozzle plate. The nozzle itself is merely a Venturi type sleeve which slips into place inside the male end and is held in place by the union nut which holds the tee and male end together. This then coincidentally furnishes the connection for steam supply and bottom drain eliminating necessity for installation of extra fittings.

The design of the pipe for the conduit is such that the flanges at the ends of each section are detachable, thus eliminating necessity for throwing these away when it becomes necessary to replace the pipe after being worn. A special design of lock joint is used which makes the establishment of a connection a matter of only a few minutes.

Material intake tees are so designed that the feed is automatically regulated to conform to the capacity of the conveyor, thereby eliminating frequent stoppages due to over-feeding. It is also impossible to feed a piece through these which in its greatest dimension exceeds the internal diameter of the conduit. At the top of the steam jet elbow there is provided an adapter section which makes it possible to install this fitting in any existing steam jet system. This also enables the turning of the riser so that an upper horizontal discharge line may be run at any angle. In addition, the adapter section acts as a wear section at the upper end of the steam jet elbow and being of relatively small dimensions, can be replaced when necessary at nominal cost and with minimum inconvenience.

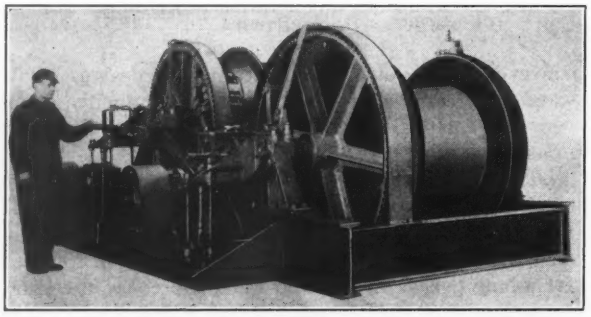


FIG. 5. A 300-HP. SAUERMAN CRESCENT POWER UNIT FOR DRAG SCRAPER SERVICE

These systems are furnished for the handling of ash and soot, in 4, 6 and 8-in. sizes.

STATEMENT BY SAUERMAN BROS., CHICAGO, ILL.

Probably the most important among Sauerman Co. past year's developments in "Crescent" power drag scrapers for storage of coal, is the increased popularity of larger sizes. There have been a number of installations during 1928 calling for 10-cu. yd. "Crescent" scraper buckets and 300-hp. power units.

One of the 300-hp. power units is shown in Fig. 5. This particular hoist has an electric torque motor control providing independent control of each drum and permitting the location of the operator's stand at any remote distance. Two small switches at the operator's station control all operations of the machine, and the drum brakes are automatically applied or released as required. Provision is also made for hand operation of clutches so that the operator can run the hoist from an alongside position when wrapping cables or making adjustments. Other important features of this hoist are the outside contracting type band friction clutches, one-piece all-steel indestructible bed-frame, gears guarded all around to prevent entry of cables, and large diameter machine-turned drums.

Scraper units of larger size have also been installed in the Leathem D. Smith type of self-unloading vessels which are conveying large tonnages of coal on the Great Lakes.

Another of the year's interesting developments in scraper equipment is the 7-yd. "Crescent" installation, shown in Fig. 6, for handling coal at the North Shore Coke & Chemical Co.'s new plant at Waukegan, Ill., notable for its comparatively simple solution of a complicated storage and handling problem. This is accomplished by the use of two special tail towers rather than a single tower or a system of back posts. These tail towers can be moved quickly to shift from one grade of coal to the other or to change rapidly from storing to reclaiming.

These special tail towers are of structural steel construction, each with a large concrete slab to make it self-supporting against the maximum pull of the cables. They are self-propelled by reversible motors, have a traveling speed of 100 f.p.m. and are designed to take a curve of minimum radius of 100 ft. They are so designed as to eliminate the necessity of outriggers or rail clamps, contributing to the ease and speed of rapid moving. Each of the towers supports a guide block 30 ft. in the air, the unusual height facilitating the rapid shifting of cables across a high pile.

Another new piece of equipment is the Sauerman "Durolite" sheave-block, designed for great strength, light weight and long life of service. These blocks have now been on the market about a year. On a coal-handling installation near Detroit, where they were installed during the development period, a set has been in continuous operation for about 2½ yr. without replacement.

STATEMENT BY STEPHENS-ADAMSON MFG. CO. AURORA, ILL.

During the past year, Stephens-Adamson Mfg. Co. of Aurora, Ill., has completely redesigned and standardized its line of skip hoists with low operating and maintenance costs as their features.

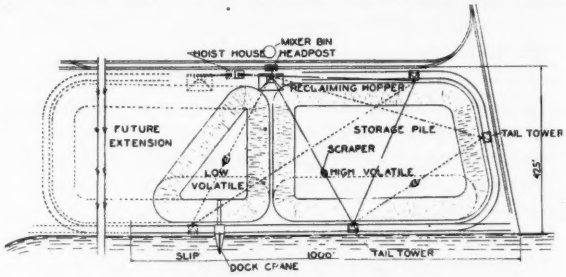


FIG. 6. AN IMPORTANT SAUERMAN DRAG SCRAPER INSTALLATION

Changes include a new series of hoisting machines, standardized buckets, support construction, control mechanism and a simplified arrangement for automatic loading.

The hoist machines have been standardized to three sizes of frames ranging in rated capacities from 3 up to 50 hp. Hoisting speeds vary from 750 up to 1160 ft. per min. and include three styles of arrangement—single bucket, unbalanced; single bucket, counterweighted and balanced double bucket.

Each of the three sizes of hoist machines is designed for several arrangements of gears for varying speeds and capacities. All gears operate in a bath of oil. Solenoid brake equipment and geared limit controls are an integral part of each machine.

Provision has been made for the three classes of control. When hand controlled, the bucket is both started and returned under hand control. In semi-

automatic control, buckets are started by hand but dump and return automatically. When arranged for full automatic control the bucket loads, starts and returns automatically.

A simplified loading device has been perfected which permits high speed loading with a large increase in the normal capacities.

STATEMENT BY C. F. ZIMMERMAN & CO., CHICAGO, ILL.

The "Pneumatram," a development of C. F. Zimmermann & Co., is a pipe line conveyor of the pneumatic type for the handling of ash, sized coal, soot and materials of a similar granular character. A column of air of required volume moving at suitable velocity through the pipe line or conduit is used as the medium for transfer of material.

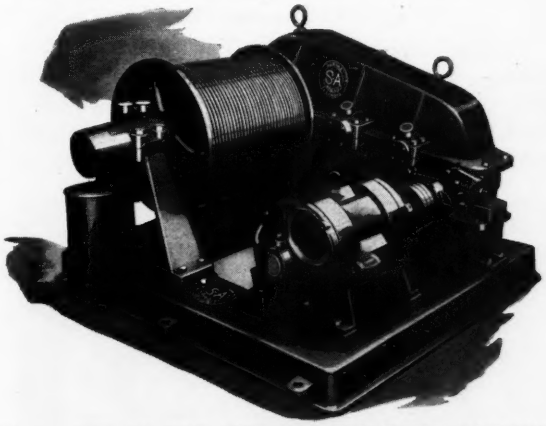


FIG. 7. ONE OF THE NEW S-A SKIP HOIST MACHINES WITH A GEARED LIMIT NOTCH AND SOLENOID BRAKE BUILT INTEGRAL

Essentially, the apparatus consists of three principal parts: 1, the pipe line or conduit in which the actual transfer of material is carried out; 2, the interceptor, to which the conduit is attached and into which the material is delivered and in which separation of air and material takes place; 3, the exhauster, which withdraws the air from the interceptor, causing a lowering of the pressure at this point whereby air is induced to flow through the conduit to replace that withdrawn and establishing the flow in the conduit on which material is carried.

The conduit consists of pipe and fittings assembled to conform to requirements, its length being anything up to 500 ft. The diameter is dependent on the capacity desired and the size of the material to be handled. Suitable feed openings are placed in the conduit at desired points through which the material is fed into the conveyor. For the handling of ash, these openings would be located in front of the ash pits of the boilers. The conduit terminates at what is termed the interceptor into which the material is discharged from the conduit and from which it in turn is discharged automatically at intervals into a storage tank, open pile, or car below. The interceptor is divided into two zones termed the suction and accumulator zone respectively. When the air and material enter the interceptor from the conduit, they are separated from each other, the material dropping and accumulating in the accumulator zone, while the air passes upward through the suction zone, through an efficient system of dust separation, where dust entrained in the air is removed, thence on to the exhauster from which it is expelled to the atmosphere.

When the material has accumulated in the accumulator zone to a predetermined weight, for which the apparatus can be set, the accumulation is automatically discharged, without attention of any kind from the operator.

Outside the interceptor and connected to it by means of suitable piping is located the exhauster, which may be of the motor driven mechanical type or of the high efficiency multiple nozzle steam jet type, as conditions may require.

As the "Pneumatram" operates on the induction or suction principle, more than one conduit can be installed. For boiler plant application, this is especially advantageous; it is possible to run branch lines to take in ash pits, combustion chambers, last passes of boilers, economizers, breechings and stack bases, from all of which removal of waste products can be effected with the one apparatus and all material delivered at a single destination. Removal can be carried out without necessity for entry by the operator into any of these points and without taking a boiler off the line or shutting it down. In effect, a vacuum cleaning result is obtained.

FIG. 8. INSTALLATION OF A ZIMMERMANN PNEUMATRAM

Excellent results have been obtained from this equipment in regular daily operation.

One such installation, having a conduit 5.75 in. diameter and 450 ft. long, handling ash from underfeed stokers, attained a capacity of 12.35 t. per hr. In this case, a multiple nozzle steam jet exhauster was used and the steam consumption was only 306 lb. per t. with steam pressure of 65 lb. at the exhauster. Another test at 12.78 t. per hr. used slightly less than 296 lb. per t. In another instance, with a conduit 7.75 in. diameter and approximately 190 ft. long, a capacity of in excess of 16 t. per hr. was attained with steam consumption of less than 275 lb. per t.

Another installation of this type is installed in a powdered coal burning plant and has given similarly satisfactory results.

The above mentioned results have all been attained in the course of regular daily operation during the past six months. Repeated and careful observations have established the fact that the apparatus performs consistently and reliably at all times.

BOILER FEEDWATER SYSTEM

Boiler Feedwater Regulation

STATEMENT BY NORTHERN EQUIPMENT CO., ERIE, PA.

NEW DEVELOPMENTS have been made in our combined feed flow-water pressure regulator and in our Type S.S. differential water pressure regulating valve. The purpose of the Copes regulator is to con-

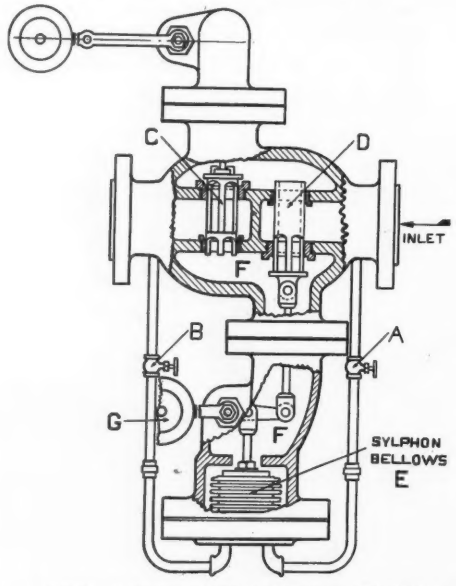


FIG. 1. COPES FEED FLOW-WATER PRESSURE REGULATOR

trol the quantity of water supplied to a boiler and also the water pressure differential. Two valves are used, both located in the same body casting. Valve C, Fig. 1, which is operated by a thermostat, controls the quantity of water supplied to the boiler according to water level and the requirements of evaporation. Valve D, which is operated by the sylphon bellows E, regulates the water pressure by maintaining the desired pressure drop across valve C.

Inlet pressure to C is on the outside of the sylphon bellows. The outlet pressure from C is on the inside of the bellows thus subjecting it only to the differential water pressure which is obtained by the weight and lever G. If there is no change in boiler pressure or feedwater header pressure, there will be no movement of valve D. Whenever a pressure drop occurs in the feedwater header pressure, less water will flow through valve D, thus reducing the pressure at the inlet of valve C and reducing the pressure in the central chamber F. This causes the sylphon to open wider which in turn opens valve D sufficiently to maintain the desired differential across the feed flow regulating valve C.

If it is desired, for any reason, to cut the pressure regulating valve D out of service, this can be done by opening valve A and closing valve B. This opens D wide and the unit then functions as a feedwater regulator only. The complete unit is furnished with 250-lb., 400-lb. or 600-lb. flanging. All parts are suitable for temperature up to 600 deg. F.

STATEMENT BY RELIANCE GAUGE COLUMN CO., CLEVELAND, O.

Among a number of recent developments in high-pressure steam specialties is an inclined type of water gage which we are just putting on the market. We have taken the standard water gage and attached it to the column in an inclined position by means of an

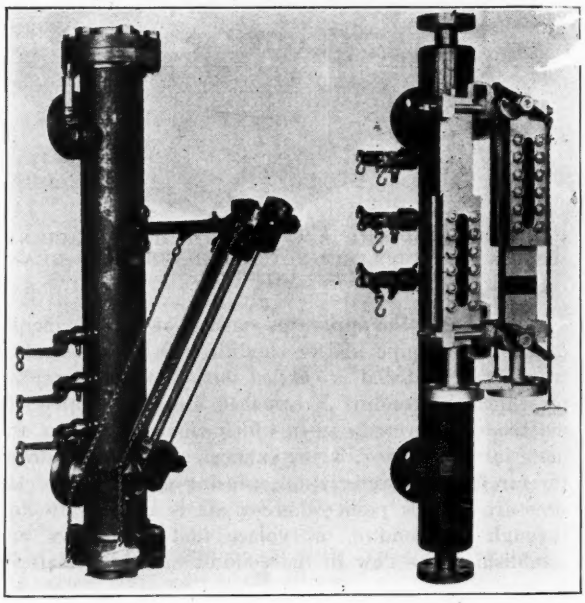


FIG. 2. RELIANCE INCLINED GAGE
FIG. 3. RELIANCE WATER COLUMN FOR 1400 LB.

adapter. This adapter, however, is of substantial character and is made of two bronze angle pieces at the top and bottom and an extension piece at the top is made of seamless steel tube welded to steel flanges and it has a steel tie plate extending from the upper to the lower fitting. This tie plate is made of steel $\frac{3}{16}$ in. thick by 2 in. wide and ties the two fittings together rigidly and in perfect alinement. This tie plate also acts as a background which makes it easier to read the water level. The guard rods in this water gage have nothing to do with the rigidity and are simply dropped in place as in any other gage, and the tie plate is not disturbed when changing glasses. It is not possible for an operator to throw the gage out of alinement since the tie plate is not adjustable. This inclined gage has an added

feature that the horizontal members can be readily cleaned by removing a plug shown at the front end.

Another recent development is a water column with water gage and gage cocks for 1400 lb. working steam pressure. The gage cocks are made with steel connections to the column and are fitted with renewable chrome seats and discs and a monel stem. The water gage with shut-off valves is made entirely of forged steel. The glass members on each side are readily renewable, and the glass is a flat glass protected from the action of the water by sheet mica. The column is made of seamless tubing with welded flanges.

STATEMENT BY STETS CO., BOSTON, MASS.

In previous types of Stets regulators, bronze was largely used for the inside parts. As higher pressures have come into use, Monel and stainless steel have been substituted in this new high pressure design. The valve of the Type E boiler feed controller is operated directly by water level movement, by means of a powerful, non-collapsible, water-filled, solid float. Any movement of

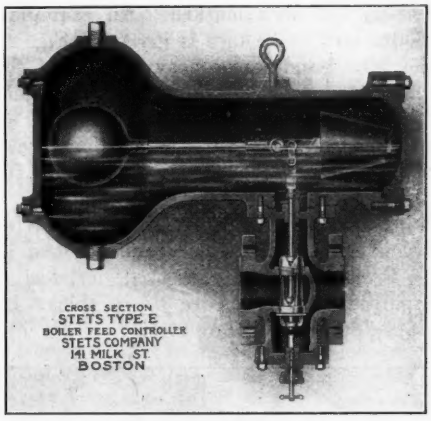


FIG. 4. STETS BOILER FEED CONTROLLER

water level in the boiler drum, due to change of boiler load, immediately readjusts the rate of feed flow. Due to the negligible mechanical friction between float and valve, a change in water level of less than ⅛ in. will cause the float to move. Water flow does not "seesaw" because the regulator works with its movement, not behind it.

All moving parts are entirely enclosed in the pressure space. There are no stuffing-boxes to be repacked or oiled, generators refilled, nor readjustments to be made for changes in temperature. At high pressures these advantages are obvious. For inspection, cleaning, or replacement of worn parts, a hand hole is provided at one end of the float chamber which gives easy access to all the inside parts without disturbing steam or water connections.

Experience since pressures of 300 lb. and over have come into use, shows conclusively that bronze is unsuitable for the higher temperatures accompanying these pressures. The metal tends to crystallize and become brittle, and the threaded sections break away. For this reason, an entirely new line of forged steel gage valves and stainless steel trycocks for Wrought Steel High and Low Alarm Water Columns built for 900 lb. pressure or above have been developed. Forged connections and wrought steel are used throughout.

Water gage valves now have full stainless steel trim. They are of the offset type so that when used with a flat gage glass, National Illuminators may be attached to the back of the flat glass, without interference with the shell of the column. Forged Steel Gage Valves are now fitted with a bolted flanged joint in the offset which can be drilled so that the gage glass may be given an inclined position if desired. By using a bolted flanged joint instead of a union coupling, the gage glass stuffing-boxes are held in rigid alinement and will stay at the angle for which they are set without frequent realining. Heavy duty trycocks are of the screwed type with bodies machined from solid stainless steel bar stock. Valve spindles are of heat treated stainless steel and may be lapped into seats while under full boiler

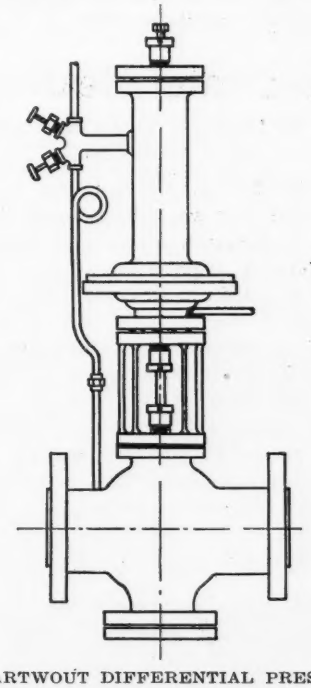


FIG. 5. SWARTWOUT DIFFERENTIAL PRESSURE VALVE

pressure. The high and low alarm mechanism is operated by solid, non-collapsible water-filled floats. Whistle valve spindle and seat are of stainless steel, heat treated to high degree of Brinnell hardness.

STATEMENT OF SWARTWOUT CO., CLEVELAND, O.

Two new types of differential pressure valves have recently been developed by us to meet the needs where extreme variations in load are found. Type S-V will maintain a constant low differential pressure under ordinary loads but will increase the differential pressure to any desired amount when the load goes to its peak. A passage-way is open around the stem from the discharge side of the body to the upper side of the diaphragm. It is in this space that we find the controlled pressure. The lower part of the diaphragm is connected into the boiler drum or at some point where it can receive boiler pressure.

At the bottom of the valve there is an auxiliary mounting which is connected to a generator placed just

below the normal water level. As the water level in the boiler goes down and the feedwater regulator approaches the wide open position, the auxiliary generator comes into operation. As pressure is built up in this generator, it exerts a pressure on the diaphragm at the bottom of the valve which in turn pushes on the spring adjusting screw. The increased tension on the spring then must be balanced by an increased controlled pressure in the valve proper. In this way, additional water can be put through the feedwater regulator valve and still retain the low normal differential pressure that insures good regulation at low ratings.

Type S-E differential pressure valve is designed to protect the economizer against damage from high pressures produced at times by pumps particularly at low ratings. This type admits just enough pressure ahead of the economizer to take up the friction loss through the economizer and still maintain the desired differential across the feedwater regulator valve.

Feedwater Heaters

STATEMENT BY CROLL-REYNOLDS ENGINEERING CO., NEW YORK CITY

GLISSON SUPER-SERVICE heater is designed to provide clean, hot water by thermal circulation of boiler water. It is a special type of heat exchanger in which the relatively impure hot water from a steam heating boiler is circulated downward through the shell and back again to the boiler by thermal action, while pure water from the hot water supply tank passes upward through the tubes and back to the tank by similar thermal action.

Distinctive, among the features of this heater, is its capacity for regulating the temperature of the hot water delivered to the storage tank. By thus maintaining uniform and moderate temperature in the hot water lines, it reduces corrosion and prevents discoloration of the water. Other advantages include increased boiler efficiency due to improved boiler circulation and to the fact that mud and rust from the boiler is deposited in the pocket provided at the bottom of the heater shell where it is easily drawn off when cleaning out the boiler.

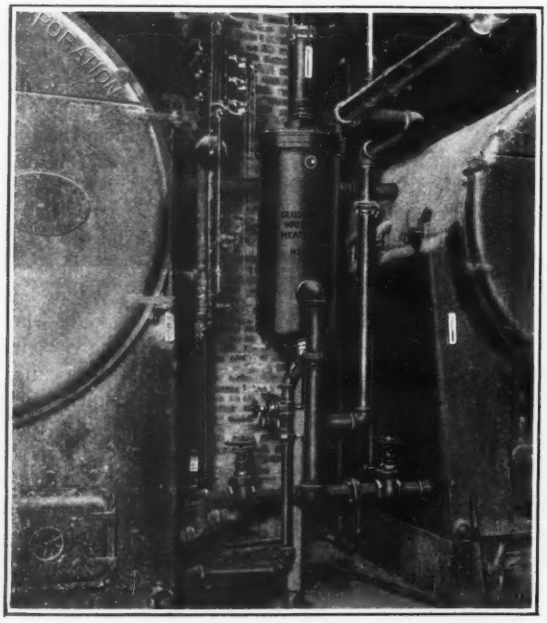


FIG. 1. CROLL-REYNOLDS GLISSON HEATER

FIG. 2. FOSTER WHEELER HEATER

STATEMENT BY FOSTER WHEELER CORP., NEW YORK CITY

Advancement in the design and construction of feed water heaters has been marked. An example of the requirements now to be met is given in Fig. 2, which shows the tube bundle and heavy heads of the feedwater heaters for the new Philo extension which are of the high pressure, bent tube type. The shells are of fire welded construction with connections welded on. The great strength of material is evident from the illustration.

Working pressure designed to be carried by heads and tubes is 900 lb. per sq. in. and the test pressure 1350 lb. Forged steel only is used, no steel castings being employed. The heads are 3½ in. thick. Bolts are of high tensile strength alloy steel.

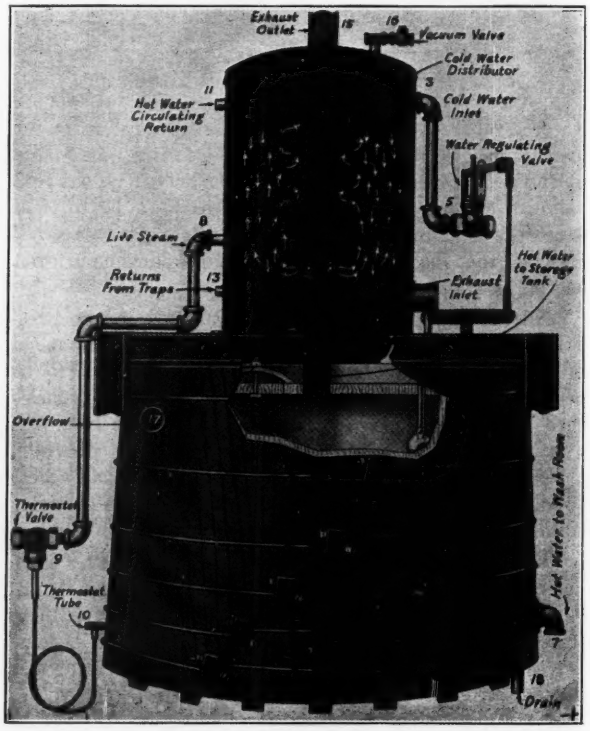


FIG. 3. MARSHALL HEATER

STATEMENT BY MARSHALL HEATER CO., DAYTON, O.

Rust and corrosion proof is the new heater we are just introducing. It is designed primarily for large uses of hot water but is used as a feedwater heater as well. The device is made in 16 standard sizes, in capacities ranging from 600 to 5000 gal. per hr. and with a storage section of from 800 to 20,000 gal. The heater section is built throughout of solid copper and the storage section of thick red gulf cypress ranging in thickness from 1½ to 4 in. depending on the size of tank.

Thermostatic control for the economic use of live steam, when live steam is used, is provided by means of a thermostatic valve which may be set for any desired temperature up to 210 deg. No back pressure is created

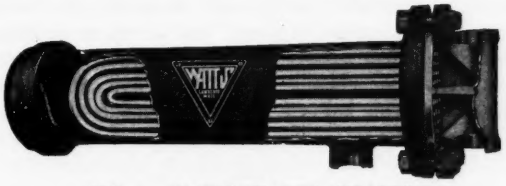


FIG. 4. WATTS WATER HEATER

on exhaust line or engine by this heater nor is there any possibility of water getting into the exhaust line to carry back to the engine. This heater is designed to act as a perfect receiver for all trap returns and is made for use of either exhaust steam, live steam or both, no changes being necessary to switch from one to another.

STATEMENT BY WATTS REGULATOR CO., LAWRENCE, MASS.

Recently a line of heat interchangers especially designed for heating feedwater and the so-called process use of hot water in and about plants have been developed by us. The heater is of "U" tube construction, having a bronze head, bronze tube sheet and copper tubes, thus preventing discoloration and insuring clear clean water. The shell of the heater is genuine wrought iron with cast iron ends. These heaters are also made with cast iron heads and semi-steel tube sheet and steel tubes for heating oil. The sizes range from 300 to 18,000 gal.

Boiler Water Treatment

STATEMENT BY LEEDS & NORTHRUP CO., PHILADELPHIA, PA.

AMONG OUR NEW productions during the past year is the equipment for measuring acidities and alkalinities of solutions, i. e., hydrogen-ion concentration, making use of the principle of the quinhydrone electrode potential as compared with that of the calomel electrode when both are in contact with the solution. The potential difference is measured with the potentiometer which is the new part of the equipment. The range of the quinhydrone electrode is more properly in the solutions of acid character but it extends to those that are slightly alkaline, namely pH. 8.5. This is the region in which boiler feedwater alkalinities are commonly maintained.

Accuracy of reading can be obtained to 0.04 pH and the range of the instrument is from 1 to 9 pH. This instrument is specifically designed for the quinhydrone electrode and when using it the electrode connections never have to be reversed. Electrically, the instrument is a null potentiometer.

STATEMENT BY PERMUTIT CO., NEW YORK, N. Y.

Increasing boiler pressures and the use of water-cooled furnace walls call for the cleanest possible boilers. This demand has been met by the installation of zeolite softeners in increasing numbers. In some localities, where natural brine or sea water is available, we have developed methods to employ it, with success, for the regeneration of zeolites. Users of evaporators for boiler feed frequently find difficulty in cracking off scale. Therefore, zeolite plants have been installed in a number of cases to soften the water before it enters the evaporators.

We have developed, also, a new type of acid feed for users who desire to maintain a predetermined sulphate carbonate ratio in the feedwater. This type of acid feed fulfills the following specifications: 1. If any part fails, it results in stopping the feeding of acid. 2. The acid is stored and measured in concentrated form, being diluted after the feed is on its way to the water. It thus occupies a minimum of space. 3. The water to be treated is measured by a meter in the supply pipe and this meter actuates a helical acid pump through electrical and mechanical connections in proportion to the

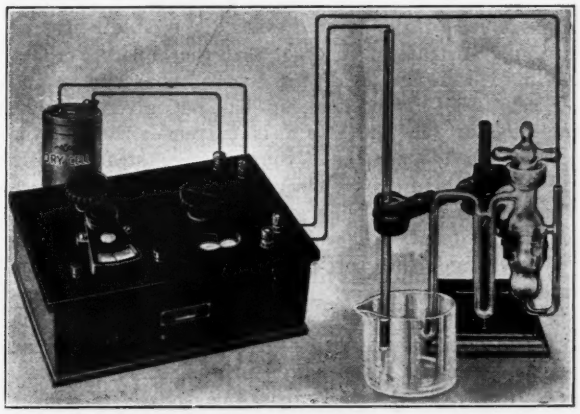


FIG. 1. LEEDS & NORTHRUP PH. INDICATOR

actual amount of water fed. If no water passes into the boiler, the meter stops and the feed stops. We are now installing one of these feeds to treat 1,730,000 gal. per day.

Return of a portion of the boiler blowoff water into the feed line is shown in Fig. 2. Since the blowoff is alkaline, this raises the pH value of the feedwater to help protect the feed lines and economizers against corrosion. This is an added factor of safety where acid feeds are used. Figure 3 shows a simple phosphate feed that we have developed for plants where a phosphate-carbonate ratio is desired instead of a sulphate-carbonate ratio. This feed has no moving parts, requires no pumps and works hydraulically. Primary orifice A causes a pressure drop in proportion to the flow. This forces water to flow through pipe P into the top of the pot, displacing an equivalent quantity of

phosphate solution through orifice S, through pipe P^1 and back into the water to be treated. The design and location of the primary and secondary orifices and the proportioning of the pot and pipe sizes have enabled us to feed the phosphate in amounts always proportional to the rate of flow of water to be treated.

STATEMENT BY REISERT AUTOMATIC WATER PURIFYING CO., NEW YORK, N. Y.

Some new features in boiler feedwater purification have been developed by us. The use of lime barium carbonate treated water for evaporators has practically done away entirely with carrying over of moisture with the vapor. The distilled water is practically free of any salts, in spite of the fact that the amount of blowdown from the evaporators is less than 2 per cent.

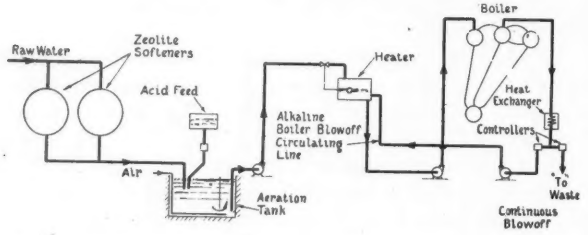


FIG. 2. PERMUTIT ZEOLITE PLANT WITH CONTINUOUS BOILER BLOWOFF AND ACID FEED WITH ALKALINE BOILER BLOWOFF PARTLY RETURNED TO FEED

In the same plant where the water for the evaporators is treated with lime barium carbonate, a considerable amount of the treated water is used directly as makeup. In spite of the fact that the boilers work at 400 lb. pressure and at ratings sometimes as high as 480 per cent, the treated makeup has not given trouble. The moisture in the steam is extremely low, never higher than 1/3 per cent. Superheaters, steam piping and turbine blading are clean and, due to the absence of sodium salts, the boiler water has not the slightest tendency to foam. The small amount of carbonate hardness is changed into soft sludge immediately when the water enters the boiler. The sludge is heavy; therefore, it settles out readily in the mud drum and in the bottom headers of the water screens. This mud has no tendency to cause foaming and priming.

Naturally, with the barium carbonate treatment there is no danger whatsoever of embrittlement. There need be no concern regarding the sodium sulphate to sodium carbonate ratio. A neutral water, as it is obtained with the barium carbonate treatment, having no tendency to cause foaming and priming, requires very little blowdown. Cost of the barium carbonate treatment is higher than the cost of the other treatments, external or internal. Nevertheless, the savings in water and fuel in most cases will justify the higher cost, not only on account of the smoother operation of the evaporators or boilers, but also because actually money will be saved. This applies even to boilers worked at low pressure.

STATEMENT BY REITER CO., ELGIN, ILL.

Boiler water purification has passed from the period where the entire boiler plant was considered as the unit. The present standard makes the individual boiler the unit, and concentration control must, of necessity, be so considered. Deconcentrating equipment provides the connection between the old standard and the new. Realization that soluble concentration introduces chemical reaction within the boiler which has an important bearing on economical steam production, and the fact that insoluble concentration is the goal of correct water purification procedure, establishes the foundation for the correct solution of the concentration problem.

Deconcentrating equipment and the continuous blowdown with heat exchanger have specific fields of usefulness. The deconcentrator separates the insoluble matter from the boiler water without the waste of blowdown, whereas the continuous blowdown system with heat exchanger is a dilution process in which heat units in the blowdown are used to increase the temperature in the feedwater. Problems involving sludge or precipitated matter are controlled to the best advantage by deconcentrating equipment, whereas the problem involving soluble concentration require the continuous blowdown system with heat exchanger. A knowledge of the water conditions and the boiler equipment in use is of primary importance in the selection of the proper equipment for the control of concentration.

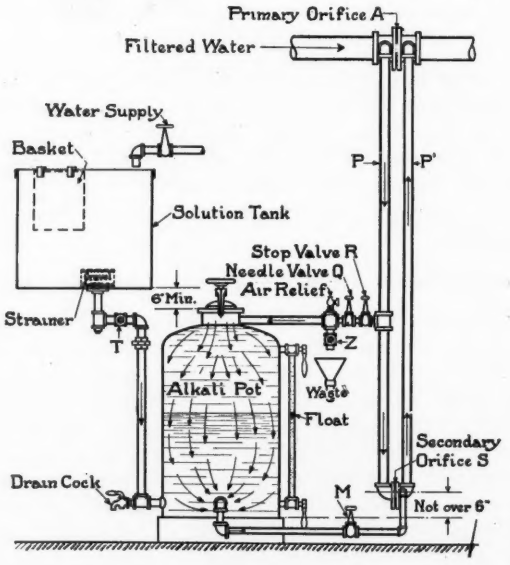


FIG. 3. PERMUTIT PHOSPHATE FEED APPARATUS FOR MAINTAINING A SULPHATE-CARBONATE RATIO

STATEMENT BY WM. B. SCAIFE & SONS CO., OAKMONT, PA.

We have just placed on the market several types of water softeners for railroads which, however, are applicable, in many cases, to water softening for power plants.

In this system, a reagent is pumped to a mixing compartment in the upper part of the tank and drops through a central reaction compartment, rising through the water in the outside portion of the tank, a Scaife water motor with registering meter forcing the water into the mixing compartment. A swing joint floating outlet pipe is used to draw the treated water from the upper level and a sludging manifold is installed to clean out the tank.

Steam Purifiers

STATEMENT BY BLAW-KNOX COMPANY, PITTSBURGH, PA.

OUR DRUM TYPE Tracyfier was developed this year because it is ofttimes desirable to place the Tracyfier in a separate drum instead of in the boiler drum.

For these conditions, the Tracyfier is assembled in the special drum at the factory and is shipped as a complete unit. No assembling is necessary on the job. The complete unit is installed in the piping exactly the same as one would install a reducing valve, or any other piece of equipment. It is often placed immediately above the boiler drum. If this position is not available, however, the drum type tracyfier can be located at any convenient point in the piping, between boiler and superheater, or steam using equipment and is very valuable for use in removing moisture, not only in large steam lines, but also in large gas or air lines. A diagrammatic drum type Tracyfier is shown in Fig. 1.

Early in 1928, a research laboratory was established for the advanced study of steam purification. Exhaustive studies have been and are being carried on here to more fully determine the fundamentals involved. Numerous improvements have been made in the design and construction of the Tracyfier based on these experiments. It has been found possible, for example, to decrease the size of the Tracyfier required for a certain boiler, especially where the drum type is used.

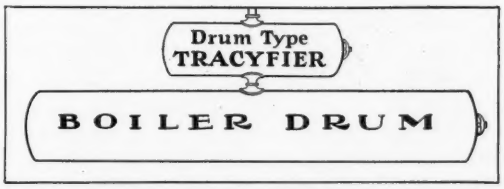


FIG. 1. BLAW-KNOX DRUM TYPE TRACYFIER

Another improvement is a difference that has been made in the relative positions of the baffle rows, that greatly increases the time interval between baffle cleanings, in those few cases where this is necessary. This means that in plants where the Tracyfiers are now cleaned, possibly once a year, the cleaning need now be done only every 2 or 3 yr. These changes have also increased the Tracyfier capacity for removing large quantities of water from steam and have reduced the already low maintenance of the Tracyfier to a negligible minimum.

STATEMENT BY COCHRANE CORPORATION, PHILADELPHIA, PA.

Cochrane steam purifier is a specially designed separator of the receiver type which is installed in the piping between the steam drum and the superheater of the boiler to protect the superheater and also the turbine or other steam using device from water and solids brought over from the boiler by priming or foaming. It has large storage capacity and leaves the entire volume of the boiler steam drum available for steam and water storage for primary separation. It is strongly built and is readily accessible. Its efficiency is not affected by the quantity of water in the entering steam.

STATEMENT BY MARLEY COMPANY, KANSAS CITY, MO.

New steam purifiers embodying features and principles radically different from former products have just been brought out by us. Advantages of both centrifugal and multi-baffle types of purifiers are combined in the new design while disadvantages of both are largely eliminated. Large free sectional areas are provided at all points thus assuring a correspondingly low pressure drop and the elimination of clogging and scaling inherent to baffle types with small passages. Being located at considerable height above water level outside of the boiler, installation is easy. Tapping of boiler drum for purifier drain is also eliminated.

Steam entering at a location dependent upon the piping arrangement is deflected downward against an orifice or nozzle plate, the vanes of which impart a high centrifugal force to the steam as it is discharged to the separating chamber below. The steam whirls rapidly, impinging against the ribbed sides of the bowl. Impurities not removed by the centrifugal force are removed by the impingement or scrubbing action. Liquids and solids pass to the external drain connection and clean dry steam passes upward and outward.

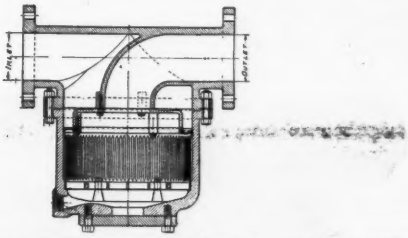


FIG. 2. SECTIONAL VIEW OF HORIZONTAL TYPE MARLEY STEAM PURIFIER

FROM THE STANDPOINT of coal cleaning, one coal may be classed as easy to wash and another as hard to wash. Many operators of cleaning plants consider that their own coal falls in the latter class. A method of comparing the relative washability of different coals has been developed at the Northwest Experiment Station of the United States Bureau of Mines, Seattle, Washington. The method is based on a comparison of the proportion of the coal which is near in specific gravity to the specific gravity at which a separation must be made to give a washed coal of the required ash content.

Specific gravity analysis of each coal is made by the float-and-sink methods and the results for each are put on the same basis by calculating out all material above 2.0 in specific gravity. The comparison of different coals is made by plotting in the form of curves the proportion of each coal which lies within different ranges of a given specific gravity point of separation. As an example, one coal may contain the same proportion of material within a range of 0.10 unit of specific gravity above and below 1.45 specific gravity as another coal contains within the same range at 1.55 specific gravity. At these two points of separation, the two coals are equivalent in washability from the standpoint of specific gravity. In this manner, it is possible to arrive at a definite comparison of the ease or difficulty of cleaning different coals corresponding to any desired point of separation.

Tube Cleaning and Protection

STATEMENT BY DAMPNEY COMPANY OF AMERICA, BOSTON, MASS.

DURING THE PAST year we have developed an outfit for applying Apexior protective coatings to the internal surfaces of condenser tubes. This outfit is operated by compressed air and insures the application of a uniform coating to the entire internal surfaces of tubes as small as ½ in. in dia. and of lengths up to 35 ft. The device may be used in coating any tubes of diameters of 1¼ in. or under.

STATEMENT BY LIBERTY MANUFACTURING CO., JEANNETTE, PA.

Speeding up condenser tube cleaning is made possible by the application of the Jiffy Gun which has been developed by us. This is accomplished by shooting rubber plugs through the tubes.

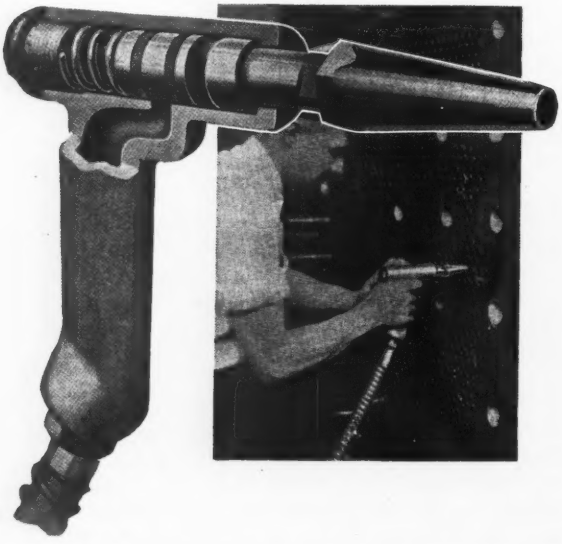


FIG. 1. LIBERTY "JIFFY GUN" TUBE CLEANER

Compactness and light weight characterize the Jiffy Gun. It is built of aluminum and weighs only 3 or 4 lb. It can be operated either by compressed air or water at a pressure as low as 50 lb. The tapered nozzle of the standard type makes it suitable for use in all tubes ranging in size from ½ to 1 in. O.D. Pressure against the tube is all that is necessary to put the gun into operation after connection has been made to the air or water supply.

STATEMENT BY WM. B. PIERCE COMPANY, BUFFALO, N. Y.

An improved model tube cleaner for water tube boilers has recently been placed on the market by us. This improved Dean has met with much success both here and abroad, particularly in England, where other methods have failed.

Although, similar to former models, in that it continues the use of the vibratory principle, the new Dean has fewer parts as well as an extension in the shell of the cleaner. The first-mentioned improvement obviously leads towards greater durability of the machine and simpler replacement of parts, when such replacement is necessary, as there are five less parts in the new model. The latter improvement makes it absolutely impossible to crowd the vibrator of the machine onto the scale, and thus assures a 100 per cent utilization of the vibratory principle and prevents even the most inexperienced

FIG. 2. PIERCE IMPROVED DEAN TUBE CLEANER

operator from attempting to chop the scale from the tubes rather than vibrate it therefrom.

It will thus be seen that the new Dean is practically fool-proof and its great popularity is due largely to this particular advantage. Many hundreds of old model Dean cleaners have been used for 15 yr. or more with only slight charges for repairs and we are sincere in our belief that the new model will last even longer because of its added ruggedness.

ACCORDING TO a recent review of developments in the electric light and power industry during 1928 by Preston S. Arkwright, President, National Electric Light Association, the production of electricity by all agencies that contribute to the public supply was approximately 88,000,000,000 kw.-hr., in addition to which another 1,600,000,000 kw-hr. were imported from Canada, these figures being based on the preliminary estimate of the U. S. Geological Survey. This total available supply was as much as the production of all the rest of the world. During the past 7 yr., the industry has added more than 13,500,000 kw. to its generating capacity, has constructed nearly 50,000 mi. of high voltage transmission lines, has doubled the output of energy and has increased the number of its customers by more than 10,000,000. Approximately 1,400,000 consumers were added during 1928, Mr. Arkwright states, making a total of 23,000,000 now served by this industry. Of these, nearly 19,000,000 are household users. Farms connected with the electric power lines in the last three years have increased by over 125,000, making a total of nearly 350,000 farms using electric service. Between 1919 and 1925, continues Mr. Arkwright, a total net increase of 6,500,000 hp. in factories was in electrical motors purchasing power from interconnected systems. On the average, each factory wage earner today has nearly 5 hp. at his command or nearly twice that of 1900. At the end of 1928, the total investment of the electric light and power enterprises in plant and equipment was carried on the books at approximately $10,000,000,000. The gross revenue from sales of current during the year approximated $1,900,000,000, out of which the light and power industry paid $175,000,000 in taxes. Advances in efficiencies of steam turbines and high pressure boilers have reduced the average consumption of coal 47 per cent per kw-hr. since 1919.

New and Improved *Prime Movers and Auxiliaries* for Wide Awake Engineers

Steam Turbines and Appurtenances

STATEMENT BY THE COPPUS ENG. CORP., WORCESTER, MASS.

WITH THE IDEA of producing a highly efficient and dependable prime auxiliary mover which would stand up under the most severe operating conditions, the Coppus Eng. Corp. has developed the Type TF turbines in sizes ranging from 1 to 60 hp.

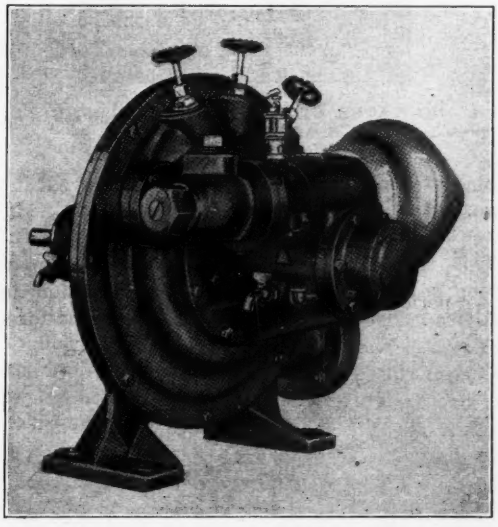


FIG. 1. COPPUS TYPE TF STEAM TURBINE

Figure 1 shows an exterior view of the turbine, the casing of which is made of close grain cast iron, supported on two substantial heavily ribbed feet with the exhaust cast integral. The turbine cover is bolted to the casing by a flange and contains the steam chamber. These turbines are furnished either with or without a constant speed governor. The governor is a self-contained Pickering centrifugal type housed in the spun aluminum guard shown at the right of Fig. 1.

STATEMENT BY THE B. F. STURTEVANT CO., BOSTON, MASS.

A new line of steam turbines has recently been brought out by the B. F. Sturtevant Co. The machine, shown in Fig. 2, is known as the Type 14 and has many interesting and unique features one of which is automatic control. It is designed to meet the demand for higher pressures and adjusts itself to all conditions. When load requirements are heavy the machine automatically provides additional nozzle area to meet it. When the load decreases nozzle area is automatically reduced. No manual operation is required.

The rotor is built for high rotative speeds and high bucket speeds which convert the high steam velocities into power. The buckets have continuous unnotched edges and are integral with the wheel.

External design of the Type 14 is new to adapt the casting better for casting from steel, and to allow for greater expansion due to high temperature demands. The casings are split on horizontal centerline and the bearing housings and governor casings are also split horizontally.

Bearings are self-alining and are supported on independent pedestals which may be water-cooled. From the bearing housings, the lower half of the turbine casing is hung. With this construction, the center height of the shaft does not change and the turbine casing is free to expand in all directions.

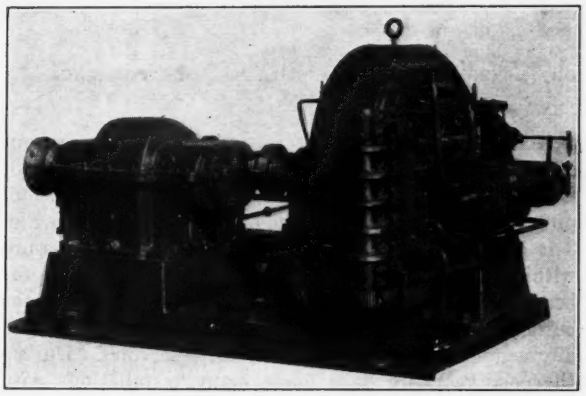


FIG. 2. VIEW OF THE TYPE 14 STURTEVANT TURBINE

Advantages accruing from such a type of turbine are obvious. Its enhanced efficiency is obtained by the immediate and accurate control of the nozzle without manual labor. The saving of live steam accomplished by this automatic control results in a substantial return on the initial investment and greater turbine efficiency.

STATEMENT BY THE D. E. WHITON MACHINE CO., NEW LONDON, CONN.

Minor changes only have been made in turbine design during the past year, but important new developments

in control apparatus have been perfected by the D. E. Whiton Machine Co.

Shaft packings is one of the improvements in turbine design. These packings consist of three groups of bronze alloy labyrinth rings, with an ejector. After "running in" any turbine at the works, the labyrinth rings do not again come in contact with the shaft. A slight amount of steam trickles along the rotor shaft until condensate has filled the grooves, after which time the packing is self-sealing for ordinary back pressures, of, say, up to 10 lb.

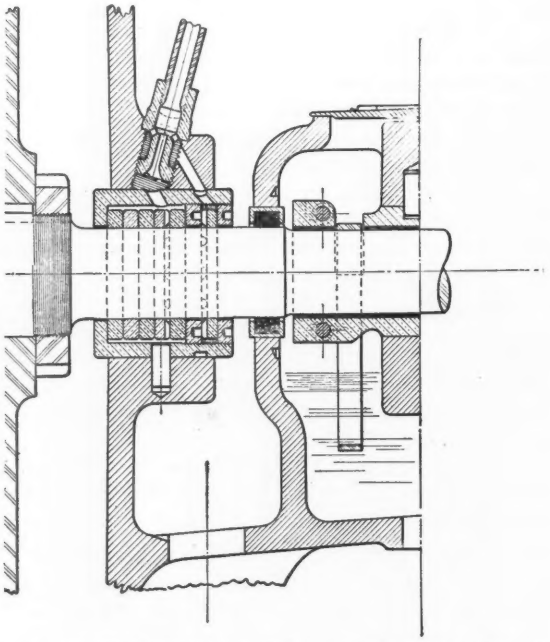


FIG. 3. CROSS SECTION OF THE D. E. WHITON MACH. CO. NEW SHAFT PACKING

Above that back pressure, the ejector feature siphons off any steam which may pass the first two groups of rings, and this will be evidenced by an occasional small puff of steam at the end of the ejector pipes. From Fig. 3 it can be observed that the higher the back pressure within the turbine casing, the more effective the ejector becomes, absolutely preventing any steam leakage at the outer end of our shaft packings, with elimination of any condensate getting into the oil reservoirs. During the past year, we have made many installations with back pressures of 40 lb. and above.

Another new development is the No-Water Stop for pumping service. A centrifugal pump depends upon the liquid being pumped for lubrication of the impeller and wearing rings, and should the suction source fail, it would likely result in a burned-out pump.

This no-water stop, Fig. 4, eliminates any possibility of a burned-out pump. It is a pressure control built into the turbine and consists of a plunger (a) acting in conjunction with independent butterfly valve of overspeed emergency mechanism at (b) and yoke in conjunction with pressure valve stem (d), a weighted can lever (e) and the spring control diaphragm within the no-water stop casing. The pressure from the pump builds up under the diaphragm, maintaining it in a floating position so that with a break in the suction line, the no-water stop throws out the overspeed mechanism closing the independent butterfly valve. This has become an important improvement for pumping service.

STATEMENT BY WESTINGHOUSE ELEC. & MFG. CO., PHILADELPHIA, PA.

Influence of the continued demand for concentrated high capacity upon the character of turbine design is manifested in the adoption of ever greater blade lengths and higher blade speeds in the final rows of the low-pressure portion of the machine. In the 60,000-kw. Westinghouse Elec. & Mfg. Co. single-cylinder unit recently placed in service in the plant of the Milwaukee Electric Railway & Light Co., and shown in Fig. 5, 34-

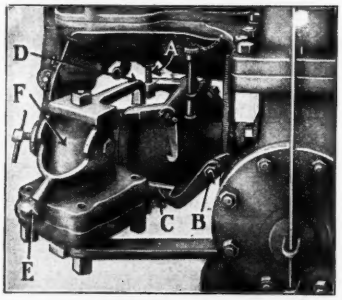


FIG. 4. NO-WATER STOP DEVICE DEVELOPED BY THE D. E. WHITON MACH. CO.

in. blades on a 78-in. dia. drum are employed at 1800 r.p.m., resulting in a normal tip speed of 1147 ft. per sec.

This turbine is equipped with a motor-operated turning gear for keeping the spindle in motion during shutdown periods, an oil-operated jacking gear for start-

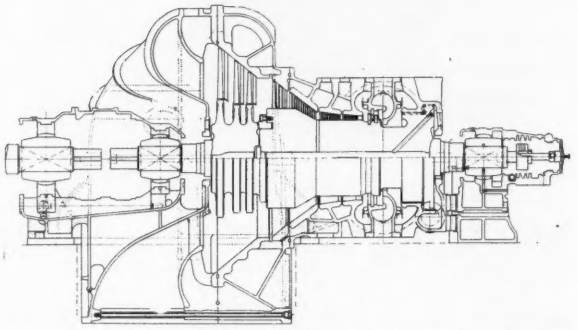


FIG. 5. LONGITUDINAL SECTION OF WESTINGHOUSE 65,000-KW. TURBINE FOR LAKESIDE STATION

ing the rotor from rest or turning it through fractional parts of a revolution, an independent high-pressure oil supply to the bearings to facilitate starting the rotor from rest by establishing the oil film and means for circulating air through the cylinder during shutdown periods to establish uniform temperatures and to aid in the proper and even cooling of the parts. This is the first unit to be equipped with the combination of all of these accessories.

Simplicity and adaptability of the impeller type oil governor are being demonstrated anew from day to day. Experience has shown that even more satisfactory results may be obtained when the governor impeller is

relieved of the duty of providing lubricating oil for the bearings and with this in view, turbines designed or installed during the past year have been provided with an additional impeller of the conventional centrifugal pump design to supply the needs of the lubricating system and the operating oil for the steam chest mechanism. The use of the centrifugal impeller on the main turbine shaft, in conjunction with an oil ejector, has made possible the elimination of the older type of pump driven from the turbine shaft through the medium of a worm and gear.

Manipulation, especially the opening, of quick closing throttle valves, has been facilitated by utilizing oil pressure to overcome the resistance of the closing springs, instead of manual effort as in the older types.

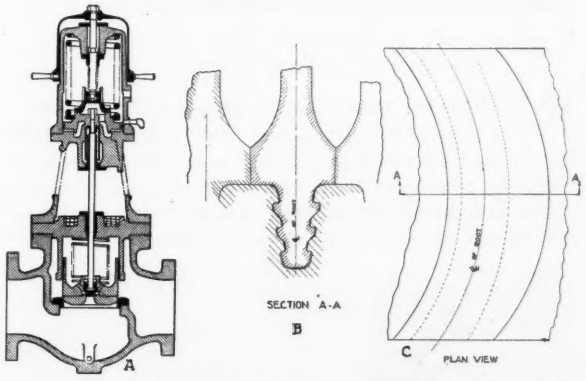


FIG. 6. A. CROSS SECTION OF WESTINGHOUSE QUICK-CLOSING THROTTLE VALVE. B AND C. SECTION AND PLAN VIEW OF WESTINGHOUSE SIDE ENTRY TURBINE BLADE ROOT

The adoption of the oil-operated valve lends itself likewise to the use of oil in place of steam in connection with the auto stop governor. Valves of this type, Fig. 6A, may be opened with practically no effort and may be quickly and easily closed.

Another development of interest is the blade fastening used in the final rows of the 65,000-kw. turbine. This consists of a serrated blade root—the serrations having the form of a buttress thread, inserted in a groove machined across the disc, instead of circumferentially. The construction is shown in Fig. 6B and 6C. Besides providing one of the strongest fastenings thus far devised, it has the important advantage of making possible a considerable reduction in the length of the rotor body, a feature of value in turbines of large capacity.

AT THE RECENT Bituminous Coal Conference in Pittsburgh, Dr. Walter Rittman described a process of manufacturing coal from petroleum, and suggested that coal thus obtained may prove to be an ideal starting material for the process of manufacturing petroleum from coal. A combination of processes was outlined by which the desire of technologists to convert crude oil entirely into gasoline may be realized.

FURNACE DESIGN is an economic problem where the cost of obtaining certain advantages often offsets the savings that follow, hence "dollar efficiency" must control furnace development.

Condensing Equipment Developments

STATEMENT BY FOSTER WHEELER CORP., NEW YORK, N. Y.

CONDENSERS and their auxiliaries have reached a stage of development at which radical changes are hardly to be expected but this does not eliminate sufficiently marked progress to interest mechanical engineers. The Foster Wheeler Corp. recently made an interesting installation shown in Fig. 1, which is one of the two highest capacity condensers ever built so far as our records go. The great size is evident by comparison with the man standing at the right of the picture. It should be distinctly understood that although these condensers have greatest capacity, their dimensions are by no means the largest ever used.

The two condensers will receive steam from a 165,000-kw. compound turbine generating unit. The total condensing surface is 2½ a. and to get this more than 79 mi. of condenser tubing is used. The cooling water required will equal a river 150 ft. wide and 6 ft. deep. Condensers are to be capable of handling 1,155,000 lb.

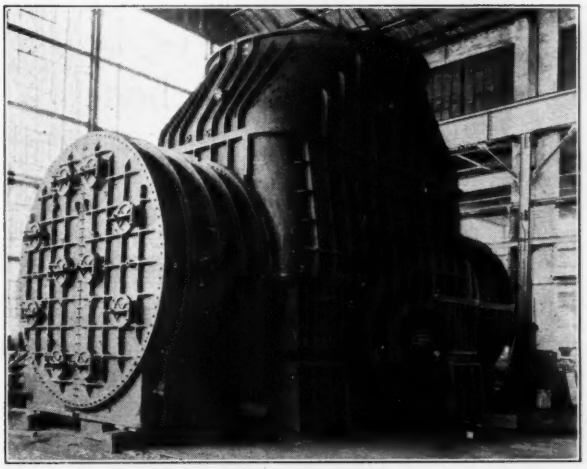


FIG. 1. FOSTER WHEELER CONDENSER FOR A 165,000-KW. TURBINE UNIT

of steam an hour. It requires 40 freight cars to transport this condensing equipment with auxiliaries, and these figures are given with the idea of furnishing an easily understood basis for comprehending condenser requirements now existing, and the success in meeting them.

STATEMENT BY THE HOPPES MFG. CO., SPRINGFIELD, O.

The barometric surface condenser, built by the Hoppes Mfg. Co., is of the vertical type and should be mounted on the building or tower as required by local conditions. The condenser has an outer shell of plate steel or ingot iron and an inner shell or skirt of ingot iron. The top and bottom heads are attached to the outer shell by welding and the top is removable.

At the bottom of the outer shell is a chamber, the top plate of which is the tube plate, and the tubes extend from the bottom plate to the upper tube plate and are rolled in place in both plates. The upper tube plate is held in place by the tubes and is surrounded by a belt

of ingot iron which projects above the tube plate to form a shallow basin and extends below the plate to form a sliding lap joint with the top of the inner shell.

This makes the upper tube plate free to move with the expansion and contraction of the tubes and no ferrules or packing is required. The cooling water is introduced into the chamber at the bottom and flows upward through the tubes to the basin above the top tube plate and overflowing the sides passes down over

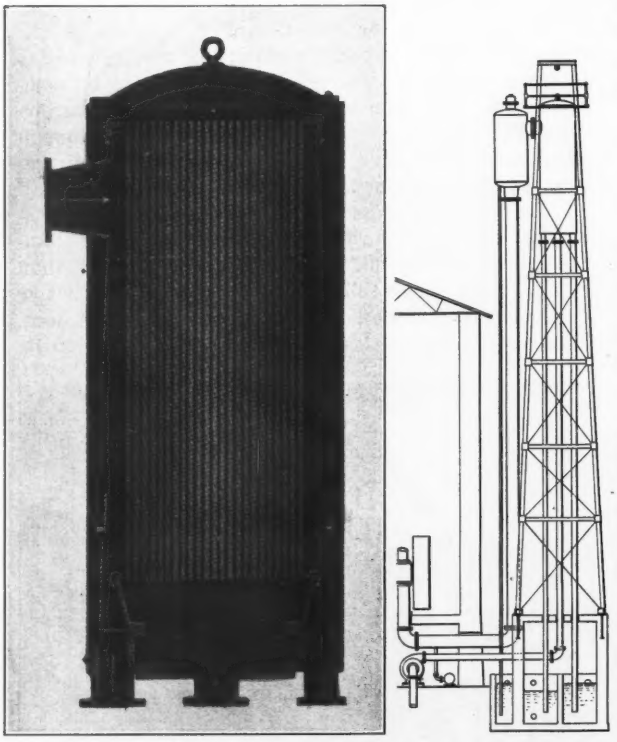


FIG. 2. A. CROSS SECTION OF THE HOPPES BAROMETRIC SURFACE CONDENSER. B. CONDENSER ERECTED ON SUPPORTING TOWER

the outer surface of the skirt to an annular chamber at the bottom from which it passes down the pipe at the left to the circulating water hot-well.

Steam enters the condenser near the top and is carried to the inside of the skirt or inner shell and comes in contact with the tubes. Entrance among the tubes is facilitated by open lanes between the tubes and the space between the tubes and the skirt.

Incoming steam which is not condensed flows downward among the tubes and the condensate drops to the bottom tube plate from which it flows to the annular space for collecting the condensate and thence down the pipe at the right to a hot-well. The exhaust coming in at the top is brought in contact with the warmest part of the tubes and in passing downward the coolest contact is made just before the air and gases leave the condenser.

Counter flow of the steam and water in this manner gives the highest possible efficiency and the exchange of heat is effected without producing destructive expansion. It will be noted that the effect of the vacuum is the same inside and outside of the tubes, the only pressure on the tubes being the hydrostatic head.

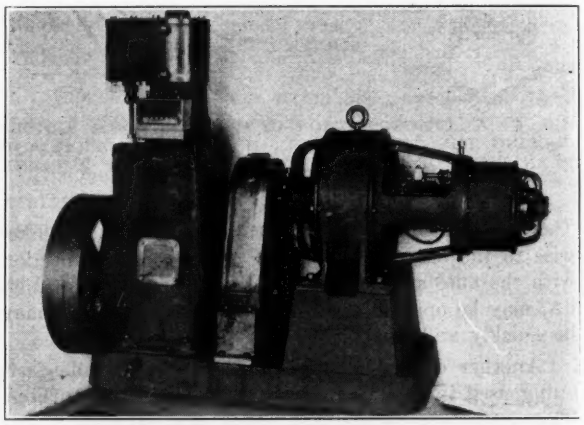
There are many advantages in this condenser over the horizontal closed type, among which may be mentioned: Lower first cost; lower cost of maintenance; lower cost of operation; simplicity of operation; no expense for space in engine room; for that reason, less expensive to install and especially where a direct contact barometric condenser is already installed.

An oil separator is furnished where one is necessary, and in such cases no vacuum trap is required, as the separator can be automatically drained by a single pipe leading down to a water seal, and requires no attention. This condenser is especially adapted to take the place of barometric or jet condensers already installed as well as for new installations.

Steam Engine Developments

STATEMENT BY ENGBERG'S ELEC. & MECH. WKS., ST. JOSEPH, MICH.

FOR SMALL capacities, Engberg's Elec. & Mech. Wks. has developed a new engine-driven alternating-current generating set consisting of one of the Engberg standard steam engines connected to a high speed alternator by a silent chain. This makes an exceedingly compact unit, low in first cost.



PHOTOGRAPH OF THE NEW ENGBERG ENGINE GENERATOR SET

We are producing the steam engine-driven machines of the type shown in capacities from 5 to 30 kv-a. and in the standard direct-connected type from 20 to 75 kv-a.

Use of the 1800-r.p.m. alternator with the steam engine through a chain drive permits the use of a standard four-pole alternator and is much better than an engine belted to a generator, as it is more compact and as the drive is more positive. The entire machine is mounted on one baseplate so that the installation is exceedingly simple. The belted alternators in the small alternating-current sets of this type can be supplied in the capacities given above to suit various current requirements and in voltages of 110, 220 and 440.

THE WORLD'S largest steam pipe has been completed by the Westinghouse Elec. & Mfg. Co. It is 7 ft. in diameter, composed of sections joined together by arc-welding. It is to be installed in a large power plant and will carry 1,600,000 lb. of steam per hour

Hydraulic Turbine Progress

STATEMENT BY THE PELTON WATER WHEEL CO., SAN FRANCISCO, CAL.

PROBABLY the most outstanding new development undertaken by the Pelton Water Wheel Co. during the past year is in connection with the installation and putting into operation of the 56,000-hp. double overhung Pelton impulse wheel at the Big Creek No. 2 power house of the Southern California Edison Co.

This water-wheel unit is the largest of its kind in the world now operating. The machine is provided with a number of unusual features, the principal of which may be enumerated as follows:

First: Water is supplied to the wheels through a direct or straight flow needle nozzle of novel design, making it possible to eliminate entirely all curves or bends between the penstock and the point of delivery of the water to the wheel.

Second: The auxiliary relief nozzle which provides safety to the penstock at periods when speed control requires throwing the water off the water wheel, is arranged with a vertical discharge to dissipate the tremendous energy from this high power relief nozzle. The stream is received by a straight flow energy dissipator of entirely new construction. After passing through this dissipator, the water is turned by a simple elbow into the wheel pit, whence it flows smoothly and without disturbance into the tail race.

Third: Governors are operated by a helical gear drive direct from the main shaft of the water wheel, thus providing a continuous and positive connection between the water-wheel runner and the centrifugal elements of the governors, under which it is possible for the governors to retain absolute control of the water-wheel unit from zero revolutions to full speed.

Owing to the massive rotating elements of this unit, the shaft alone weighing practically 50 tons, and the total weight being approximately 250 t., a specially improvised system of lubrication for starting and stopping is provided and a novel water-cooling system, used for the first time in this installation, maintains a maximum bearing temperature which under extreme full-load conditions has never exceeded 32 deg. C.

These primary or major improvements, together with numerous other mechanical features, made it possible to start up this huge unit, and after completing all electrical and hydraulic tests and adjustments, place it in commercial service delivering 40,000-kw. within slightly less than 16 hr. from the first occasion on which water was turned on. The unit shows a remarkable characteristic of sustaining efficiency at high loads and over loads. Owing to this, the unit is actually being operated with excellent economy at a continuous output of approximately 50,000 kw. or about 70,000 hp.

We have made great progress in the design and progress of butterfly valves for free discharge so that under proper conditions valves of this type offer an economical solution of a perplexing problem. Automatic plant operation is growing apace and is the result of numerous improvements in devices for automatic control and new apparatus for accomplishing results hitherto unprocurable.

Our company has made a considerable number of such developments and has found in most of these, advantageous use for a hydraulic primary control device which replaces the ordinary governor. We have also developed an entirely new differential pressure relay which finds great use in automatic plants and in water works, pressure regulating and control systems. This device operates by a differential of pressure between two points in pipe line or penstock and is not influenced by a uniform rise or fall in pressure.

STATEMENT BY S. MORGAN SMITH CO., YORK, PA.

The most important step made by S. Morgan Smith Co. in 1928 has been the development and introduction in the United States of the Kaplan automatic adjustable-blade hydraulic turbine runner. This type of turbine has come into extensive use in European countries in the past few years but has never been adapted in this country until this year. The outstanding characteristic of this turbine is the high efficiency obtained at part load which, up to this time has been the principal disadvantage of the propeller type runner. We are now building several turbines of this type, the first one contracted for being the unit for the Devils River No. 9 Plant of the Central Power & Light Co. in Texas.

Internal Combustion Engines and Appurtenances

STATEMENT BY BESSEMER ENGINE CO., GROVE CITY, PA.

EITHER FUEL OIL OR GAS, whichever the owner may prefer, may be used in a Diesel oil engine which we have developed and perfected. One of these engines is in service in the plant of the Excelsior Brick

FIG. 1. BESSEMER CONVERTIBLE GAS AND OIL ENGINE

Co. at Fredonia, Kan. Since its installation, it has been operated on natural gas. This is a six-cylinder, 410-hp. engine which furnishes the entire power output for the Excelsior plant. In every respect, the engine has been a success. It is economical in fuel consumption, unfailing in its performance and remarkably free from servicing.

This engine, which is a Bessemer Diesel innovation, was designed to meet a definite need for large unit power plants in sections now served by moderate priced gas but which anticipate an increase in fuel cost which will make gas fuel too costly for power purposes. In such localities, where a change of fuel may become necessary the gas-oil Bessemer Diesel can easily be changed

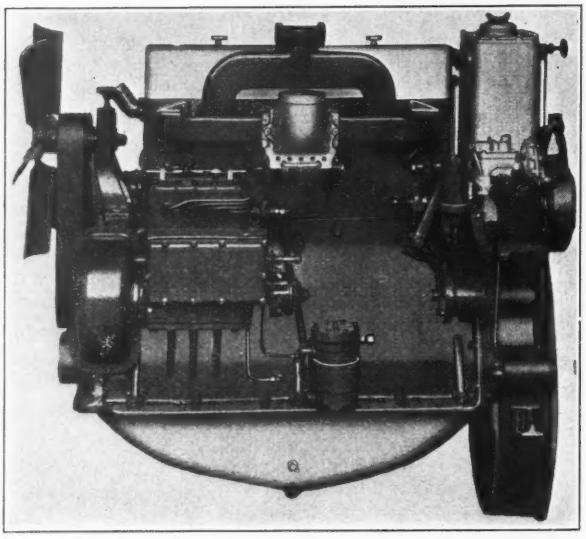


FIG. 2. BUDA LIGHT WEIGHT, HIGH-SPEED M. A. N. DIESEL ENGINE

over to operate on fuel oil or, if the advent of gas is anticipated, it can be started up as an oil engine and later changed over to gas. The gas fuel change-over equipment is Bessemer designed, and can be adapted to either type of fuel at but slight expense and with but little effort. When operating on gas fuel, they show a high operating efficiency and the same high degree of performance as when operating on fuel oil as a full Diesel engine. These Bessemers are adaptable to any type of heavy-duty service.

STATEMENT BY BUDA CO., HARVEY, ILL.

Our outstanding new product is the lightweight, high speed Buda-M.A.N.-Diesel engine illustrated in Fig. 2. The engine shown in a 4-cylinder, 6 by 8 in. size which develops 92 br.hp. at 1000 r.p.m. This type is also manufactured with four cylinders 6½ by 8¾ in. developing 120 br.hp. at 1000 r.p.m. and with six cylinders of same size developing 180 br.hp. This engine is of the 4-cycle, solid fuel injection type and weighs only about 35 lb. per br.hp.

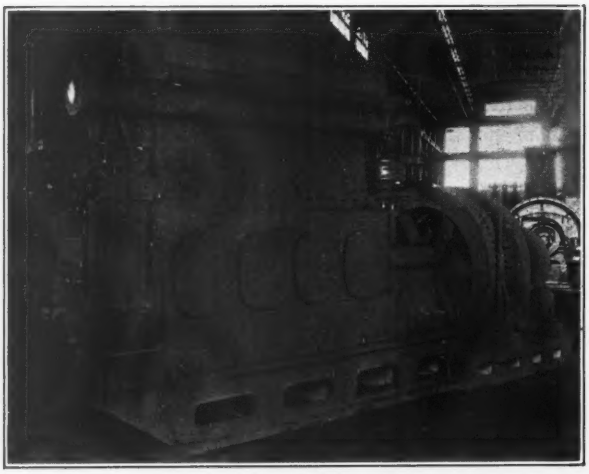


FIG. 3. BUSCH-SULZER SMALL TYPE 4-CYCLE, AIR INJECTION DIESEL ENGINE

STATEMENT BY BUSCH-SULZER BROS. DIESEL ENGINE CO., ST. LOUIS, MO.

Scavenging air is supplied by a turbo-blower instead of by a reciprocating pump in the new 3750-hp. Diesel recently installed by us at the plant of the Tucson Gas, Electric Light & Power Co. Turbo-blowers are supplied also to large marine Diesel engines which we have built for the U. S. Shipping Board.

Type F unit shown in Fig. 3 is a line of engines ranging from 165 to 450 br.hp. which has recently been developed to meet a growing demand for quality Diesels in small sizes. These engines are of the 4-cycle, air injection type, built with a rigid enclosed combined bedplate and crankcase with cylinders "en bloc" and removable cylinder liners.

STATEMENT BY CHICAGO PNEUMATIC TOOL CO., NEW YORK, N. Y.

Convertibility from gas to oil engine or vice versa is a feature recently arranged for our engines particularly for use in those localities in which the supply of gas is uncertain or dwindling at such a rate that the fuel cost is likely to be prohibitive in a few years.

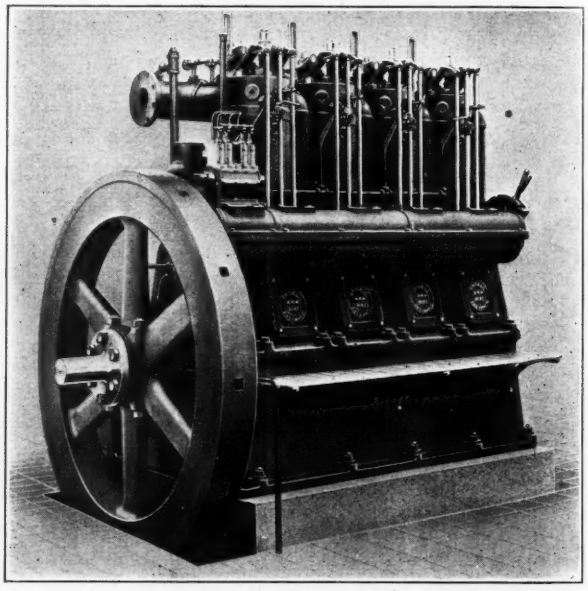


FIG. 4. CHICAGO PNEUMATIC CONVERTIBLE GAS AND OIL ENGINE

Need for a convertible unit grew out of a demand for individual well-flowing units for which the most economical and convenient compressor drive was the gas engine. The change was first made in our Type RH Benz-Diesels which were provided with gas cylinder heads, magnetos and mixing valves for gas. The base and crankshaft were also extended to accommodate a 2-stage, tandem, vertical compressor suitable for oil field conditions.

First units installed were placed in the West Texas district. West Texas gas is excessively dirty and contains a large hydrogen-sulphide content. Gas engines will operate on it but the upkeep is troublesome, and as all means of purifying the gas proved expensive, the owner of a two-individual gas-well flowing compres-

sor in that field, cast about for a solution of the gas difficulties. Investigation brought out the fact that the conversion back into a Diesel engine could be accomplished right in the field at comparatively small cost.

STATEMENT BY CLIMAX ENGINEERING CO., CLINTON, IOWA

Two new gasoline engines have been added to our current line, both of which have a bore of 6 in. and stroke of 7 in. developing 100 and 110 br.hp. at speeds of 1000 and 1200 r.p.m. respectively in the 4-cylinder type, which is known as our "Blue Streak Four" and 150 and 165 br.hp. at 1000 and 1200 r.p.m. respectively in the 6-cylinder type, which is known as our "Blue Streak Six."

Mean effective pressures of 100 lb. per sq. in. at 1000 r.p.m. are secured on both types with fuel rates of less than 0.6 lb. per br.hp-hr. At reduced speeds, the torque increases materially with remarkable stability, giving proper characteristics for crane, shovel and other industrial applications. By a slight reduction in power, fuel rates well under 0.55 lb. have been secured.

STATEMENT BY C. & G. COOPER CO., MT. VERNON, O.

To meet the growing demand for a small, dependable, direct-connected compressor unit, we have recently introduced our Type 16 convertible gas or Diesel engine which is a four-cycle, horizontal machine of the center crank type; self-contained, and built throughout to withstand the pressures imposed by the high compression of the Diesel cycle. The engine is so designed that it can be used either as a gas engine, or with a few changes, as an airless injection, full Diesel oil engine. Using either gas or oil, it is conservatively rated at 50 br.hp. at 250 r.p.m.

Objection to center crank construction and trunk piston design has been eliminated by making the crank shaft from an unusually heavy forging and the piston with a long skirt. Accessibility is retained by the development of a new hinge type connecting rod which permits easy adjustment of both crank and wrist pin bearings. The unit was designed and built primarily for compressor service where continuous operation is necessary. The compressor cylinders are separate pieces and are bolted to the main frame, so that either single or two-stage compressors may be used. The two-stage cylinders are of tandem, single-acting construction, with intercooler shell and both cylinders cast in a unit. This

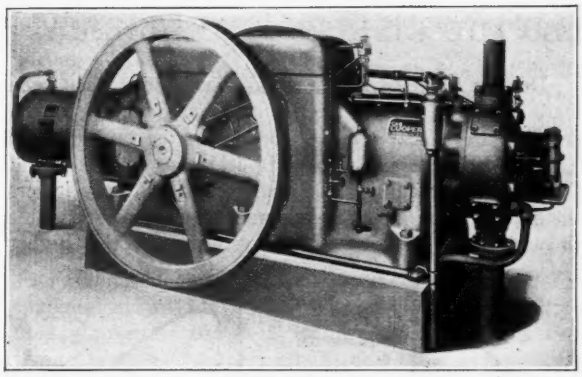


FIG. 6. COOPER CONVERTIBLE GAS AND OIL ENGINE

results in a very compact and efficient machine which can be easily installed, and represents an ideal compressor for industrial installations. Additional economy of floor space has been achieved by supplanting the usual tie-rod drive by a pair of vanadium steel yokes which transmit the power direct from the power piston to the compressor piston rod, thus eliminating both power and compressor crossheads.

Use of Timken roller bearings on the main shaft effect a further saving in weight. These bearings reduce friction, minimize the risk of burning out the main bearings, and eliminate the close attention required by the old-type babbit bearings.

STATEMENT BY FAIRBANKS, MORSE & CO., CHICAGO, ILL.

Most of our developments for 1928, as far as Diesel engines are concerned, have been in the extension of the range of application for such units and the broadening out of our line of engines for auxiliary service. No changes have been made in the standard line ranging from 30 to 840 hp. The important addition to the list of ratings has been a 6-cylinder, 800 r.p.m., 90-hp. unit in a block cylinder design. This unit is built mainly for dredging and excavating machinery, industrial locomotives and similar mobile and semi-mobile services.

Application of Diesel engines for direct drive to turbine pumps and the development of a line of auxiliary units direct connected to compressors on one end and to a generator on the other, are typical of some of the extensions which have been made in the field of application.

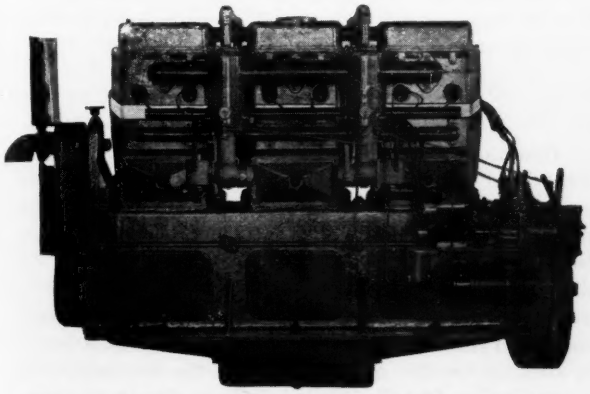


FIG. 5. CLIMAX "BLUE STREAK" GASOLINE ENGINE BUILT IN FOUR AND SIX CYLINDERS

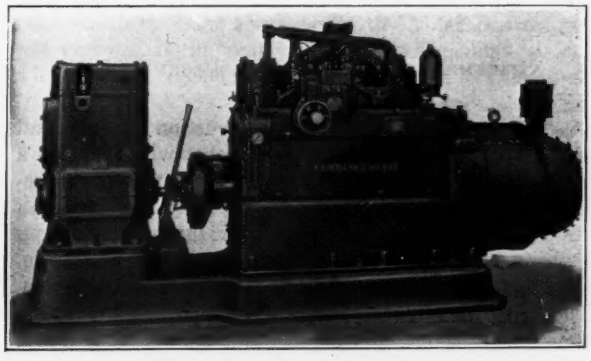


FIG. 7. FAIRBANKS-MORSE DIESEL ENGINE-COMPRESSOR-GENERATOR AUXILIARY UNIT

STATEMENT BY THE HOOVEN, OWENS, RENTSCHLER CO., HAMILTON, O.

During the past year, rapid development has been made in large double-acting, two-cycle engines in increasing the rotative speed for stationary applications. This is an important step as it decreases the weight of the engines per horsepower and correspondingly lowers the initial cost. This development was made possible through perfection of the scavenging at the higher

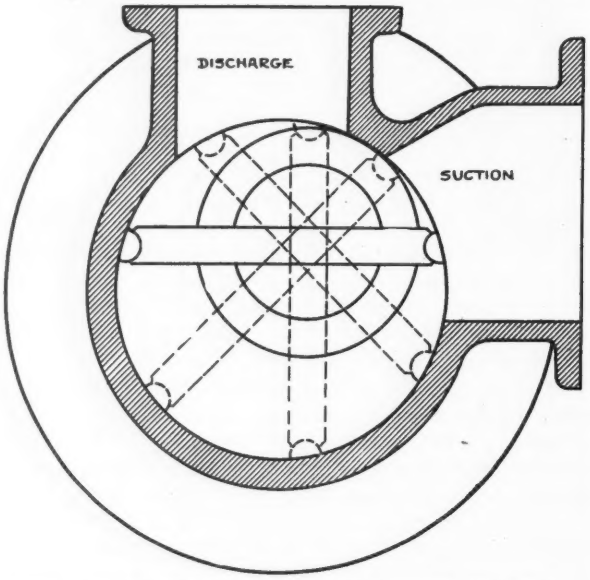


FIG. 8. MARTELL PUMP USED AS A SUPER CHARGER

speeds and a further step was also taken in applying solid injection to the large units.

Two engines of 11,000 hp. have been installed during the past year in the electric works of the Hennigsdorf-Berlin, Germany, Power Station. The engines are 10-cylinder, 23½ by 36 in. stroke operating on solid injection and are used as standby units, running only a few hours per day. These engines have been subjected to elaborate shop tests and have proved highly successful in actual operation.

Although no large installations have as yet been made in this country, the complete information is available to manufacturers under license in this country and the comparatively low initial cost, with the great saving in fuel due to the Diesel engine economy, should find a large field in the generation of power for standby purposes.

STATEMENT BY THE MARTELL PACKINGS CO., ELYRIA, O.

An oil pump for internal combustion engines and other machinery requiring a pump that will maintain a flow of fluid in one direction, independent of the direction of rotation has been designed by us. It is a revolving single blade, positive pressure pump and is built in two types, one being automatically reversing, the other non-reversing but rotatable in either direction. The reversing pump is entirely automatic in operation, the fluid pumped actuating the internal reversing sleeve valve upon change of engine direction. The non-reversing pump is built with a center discharge connection and two suction connections; one on each side of the body.

Both types can be built in units of one or several sections having a common drive shaft. With a triplex pump, one section can be used for force feed lubrication supplying oil at any desired pressure, the second section to supply oil for splash lubrication, while the third section can pick up the oil in the sump, forcing it through a filter and delivering it to the supply reservoir. Pressures up to 300 lb. are obtainable. Capacities range from ¾ g.p.m. upwards at any desired speed.

Each section of the triplex pump shown has a capacity of four g.p.m. or a total of 12 g.p.m. for the three sections, at 1000 r.p.m. The compactness of the unit will be immediately appreciated.

Another interesting development of the Martell "Romec" pump is its adaptation as a supercharger for internal combustion engines, its compactness making it easily adaptable to any engine frame. Supercharger pumps are built in sections with a common drive shaft with the one-piece blades set at relative angles, as for example, at 120 deg. for a 3-section pump; this assures an even flow of air to the engine and balances the revolving parts. The installation of a Romec supercharging pump enables a Diesel engine manufacturer to increase his power output by 150 per cent. Pumps for supercharging can run at engine speeds or higher, and can be built for any desired capacity. The external design of the pump housing is readily adapted for any particular engine design.

Silent relief valves for fluids, which are designed to eliminate, entirely, the chatter and pounding of the

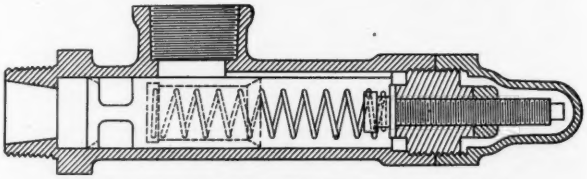


FIG. 9. MARTELL SILENT RELIEF VALVE

valve on its seat, common to valves of previous types are now made by us. Silence is assured by eliminating the valve seat. The valve is extremely sensitive and therefore is especially desirable where low pressures are to be maintained. Control spring is entirely free when the valve is not in operation, thus assuring maintenance of spring tension over long periods of time and giving a wide range of adjustment. The valve will operate perfectly in any position.

STATEMENT BY SUPERIOR ENGINE CO., SPRINGFIELD, O.

Operators in the Seminole field where conditions were ideal for gas lift have learned that the cost of electricity there is prohibitive. It was for such service in particular, as well as for air lift, repressuring, absorption gasoline plant, booster and vacuum service that we developed our duplex direct-driven compressor unit.

This unit is powered by a 2-cycle gas engine direct connected through its crosshead to the compressor which is situated on the opposite side of the crankshaft as shown in Fig. 10. The whole unit is rigid and accessible as well as simple in construction and is built for heavy-

duty and continuous service and yet it is moderate in weight to permit of easy transportation. It is self-contained, therefore it can be set up in a short time.

To avoid serious damage from liquids or excessive pressures in compressor cylinders, an inexpensive "weak link" is provided which may be readily replaced.

STATEMENT BY THE UNION DIESEL ENGINE CO., OAKLAND, CALIF.

We will soon put on the market an industrial Diesel engine of the four-cylinder type. It has a bore of 6½ in. and a stroke of 9½ in., and operates at 600 r.p.m. It is rated at 60 hp. It will develop 85 hp. for spurts at 600 r.p.m. The length from the after side of the fan pulley is 70 in. The height from the center of the shaft to top of the engine is 48 in. It weighs approximately 5000 lb. The cylinders are cast separately. A five-bearing crankshaft is used. Camshaft is overhead and to one side of the cylinder heads. All moving parts are enclosed. Full force-feed lubrication is used. Injection valves are mechanically operated with fuel pressure and opening of injection valve under governor control. The overhead camshaft insures uniform injection valve maintenance and adjustment, and therefore uniform distribution of work in all cylinders. Each injection valve may be easily and accurately set for lift, and this will be maintained for several hundred hours. There is no packing in fuel pump. Plungers are lapped.

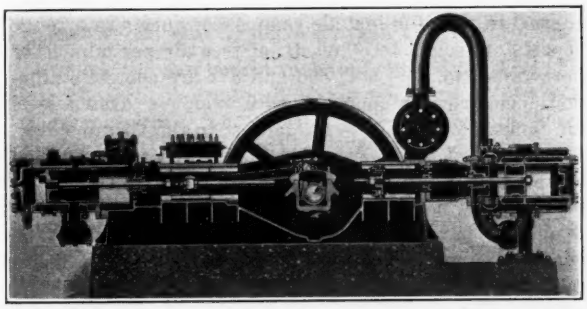


FIG. 10. SUPERIOR 2-CYCLE GAS ENGINE-COMPRESSOR

STATEMENT BY WINTON ENGINE CO., CLEVELAND, O.

One of our outstanding developments in the past year is our new type 4-cycle airless injection marine Diesel engine. Our model 8-138 has eight cylinders of 8 in. bore and 10 in. stroke, developing 300 hp. at 700 r.p.m. weighing 9000 lb. complete with all equipment. Smooth performance is accomplished by precise balancing and ruggedness of construction. This engine can be built in sizes ranging from 50 to 1500 hp. and for both medium and high-speed service.

STATEMENT BY THE WOLVERINE MOTOR WORKS, INC., BRIDGEPORT, CONN.

Our 2-cycle marine type Diesel engine is one of our recent productions. This engine, in its three-cylinder size, develops 37½ hp. at 450 r.p.m. It is direct connected to a 25-kw., 110-v., 6-pole compound wound generator and both generator and engine are mounted on a single-bed plate and direct coupled. This type is available in both larger and smaller sizes.

Distallation Products of Coal

INTEREST of American engineers in the distillation products of coal is increasing, according to the Prime Movers Committee of the N. E. L. A. They now appear to have a better appreciation of the objectives of the various processes, which are, either to produce a cheap treated fuel for power plant use or to provide a smokeless domestic fuel.

During the past year, notable contributions have been published but there have been no startling developments in any of the processes during this time. Steady progress has been made on the commercialization of certain of these methods and these advances are being followed closely by all interested engineers. A number of new installations of commercial size will be put into operation within a year, both in this country and abroad.

Test results on British commercial plants and on the retorts developed in their own laboratories have been made by the Fuel Research Board of Great Britain. These results are valuable to all who are following the development of low temperature processes. No plant records or results on American commercial plants are yet available. Economics of low temperature carbonization are now receiving critical consideration and the financial factors involved are now quite generally recognized.

BY-PRODUCTS WILL SOON BE ON THE MARKET

Developments in foreign countries have been generally confined to improvements of processes now in commercial or experimental stages. The construction of new high temperature coke ovens in Germany and the extensive plans to provide a domestic market for the gas and small coke from such ovens, have lessened to some extent the enthusiasm for low temperature processes in that country. By-products of low temperature carbonization have received much study recently, for these liquors will soon be available in quantity from commercial plants.

Possibilities of hydrogenation have not been fully extended, though progress has been made during the past year. Powerful interests have secured patent rights to certain of the processes and commercial developments are now under way. The relation of low temperature carbonization as a means of furnishing cheap fuel to the central power stations is stated concisely in the following paragraph:

"The question arises whether it would be advantageous to split the coal outside the boiler furnace into its gaseous, liquid and solid constituents and to burn these under the boilers adapted to each. This would require: 1. A continuous low temperature carbonization apparatus, elastic in operation, feeding semi-coke to the furnace regularly and under control. 2. Such apparatus to be of small weight and bulk so it could be built to overhang the front of any boiler above the grate. 3. Adoption of such apparatus to replace the automatic stokers of existing boilers so as to drop the semi-coke at about 900 deg. F. from the retort by an inclined plane into the fire-bed. 4. Effecting carbonization with minimum heat consumption. 5. Keeping down operating, depreciation and investment costs on the apparatus."

COMPRESSED AIR AND REFRIGERATION

New Developments in Compressed Air Machinery

STATEMENT BY AMERICAN AIR COMPRESSOR WORKS, BROOKLYN, N. Y.

WE HAVE DEVELOPED a directly connected compressor which is used in our sprinkler service and also in other classes of work where service requirements are intermittent. This machine, known as the Class E-C-D compressor, is a direct connected unit, without gears, belts or chains and is equipped with the Fairhurst patented automatic plate type valve. The piston, connecting rod and crankshaft are all of the same high-grade material meeting requisites of high speed and durability. The compressor is mounted on a bed plate or sub-base with a machined surface, set in true alinement with the motor shaft. The shafts of the compressor and motor are connected with an ingenious fan-ribbed flywheel and flexible coupling. Each unit is provided with a regulation strainer and starting release cock. These units are made up with either direct or alternating-current motors and are sold only as complete assembled units. When used for intermittent duty, they are provided with automatic starting and stopping devices and automatic unloaders.

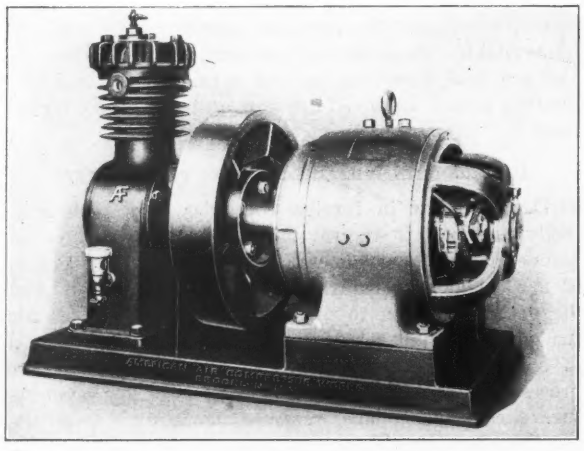


FIG. 1. AMERICAN AIR COMPRESSOR WORKS, DIRECT CONNECTED COMPRESSOR. FLYWHEEL RIBS FORM A COOLING FAN

STATEMENT BY BRUNNER MFG. CO., UTICA, N. Y.

The Brunner line of air compressors has been increased in range to include compressor outfits in a range of sizes of from 1 to 30 cu. ft. of free air per min. The new units, No. 866, 867, 868 and 878 are complete automatic electrically operated with seamless drawn steel air tanks. Model 878 is the largest in the Brunner line. It consists of a two-cylinder heavy-duty, water-cooled compressor belted to a 7½-hp. motor and displaces 30 cu. ft. per min. The water cooling is a feature common to all the larger units and permits these machines to run continuously at a low temperature and yet maintain a high efficiency. With the exception of No. 878, all the units are furnished complete, mounted on a steel frame with the air receiver installed underneath. In Model 878, the tank, starter, controller and check valve are shipped separately for installation by the user.

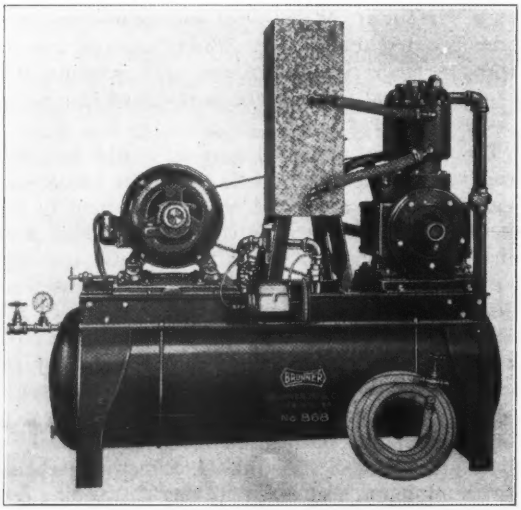


FIG. 2. BRUNNER MFG. CO. MODEL 868 AUTOMATIC AIR COMPRESSOR

STATEMENT BY THE CONNERSVILLE BLOWER CO., CONNERSVILLE, IND.

One of our recent developments is the production of high inertia impellers for the R-S series of rotary posi-

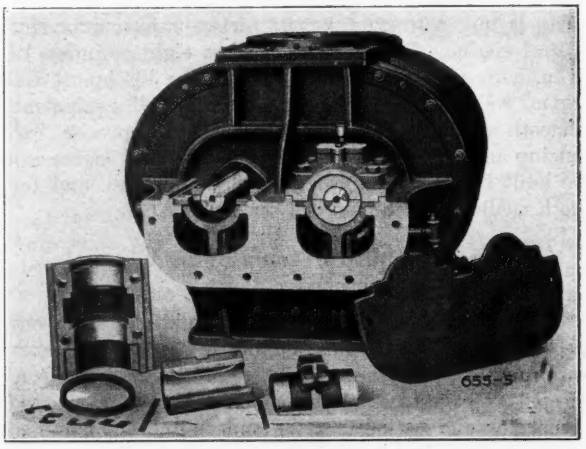


FIG. 3. R-S BLOWER MADE BY THE CONNERSVILLE BLOWER CO.

tive blowers and gas pumps. A new fundamental theory of design is incorporated in these impellers. In older types, there has been angular displacement of the impellers and torsional reactions of the shafts, caused by the variation in the pressure loads on the impellers at different points in the revolution. By substantially increasing the weight of the impellers and by more exact balancing, these parts have been given a high inertia value or flywheel effect that reduces this angular distortion, permitting a reduction in the clearances between moving parts. This results in higher efficiencies and the delivery of more air for the same power input.

Due to the inertia value of these impellers, the working load is more evenly distributed over the entire circumference of the gears, rather than concentrated on a few teeth at opposite portions of the revolution, with a resultant increase in the life of these parts, even at higher speeds and increased pressure loads.

Another new feature in the "R-S" blowers is the use of renewable split sleeve ring oiling bearings. In this bearing, the shell is split along the horizontal center. By removing the cap, the top half of the bearing may be lifted off. Then the lower portion of the old bearing can be rolled from under the shaft and a new section slipped into its place without removing gears.

STATEMENT BY THE GARDNER-DENVER CO., QUINCY, ILL.

Among the new products manufactured by this company of particular interest is the new line of portable air compressors. These units are powered by four-cylinder, heavy duty, "L" head Buda gasoline engines, with a rated horsepower greatly in excess of the requirements of the compressor. This ample reserve power insures economical operation and long life.

The compressors are of the vertical, single acting, duplex type. With all superfluous weight eliminated, their compact, simple construction makes them ideally suited for portable use.

Following are some of the features of the compressor. Lubrication is by combination plunger pump and splash, and troughs are so constructed that sufficient supply of oil is insured even when the machine is tilted considerably on uneven ground. All parts requiring periodic inspection and adjustment are readily accessible; these include valves, crank case and cylinder head. Minimum clearance between piston and head insures high volumetric efficiency. Pistons are automobile type, light weight. Valves, of special Duo Plate type, are easily removable for inspection and adjustment. All reciprocating parts are accurately balanced, resulting in quiet operation and freedom from vibration.

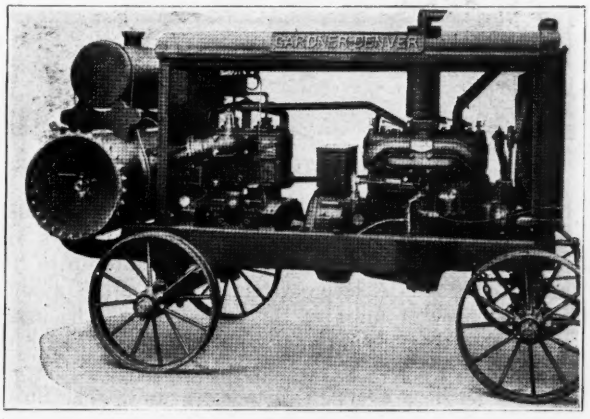


FIG. 4. GARDNER-DENVER CO. PORTABLE COMPRESSOR UNIT

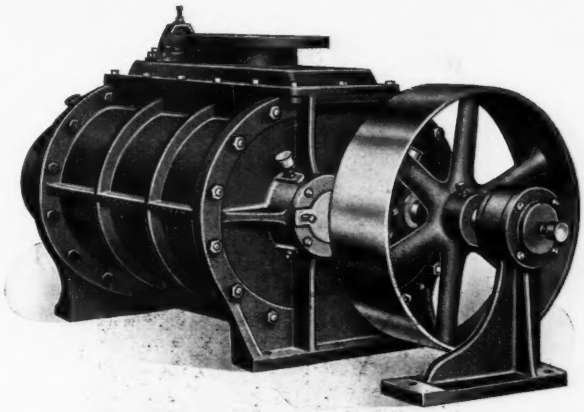


FIG. 5. ROOTS BLOWER USING ANTI-FRICTION BEARINGS

STATEMENT BY THE P. H. & F. M. ROOTS CO., CONNERSVILLE, INDIANA

In this statement, we announce the general adoption of anti-friction bearings for our blowers. The standard line of blowers carries Timken or SKF heavy duty roller bearings upon the purchasers' specification, and the Acme line of smaller units carries roller or ball bearings upon specification.

The Roots Blower construction has been re-designed entirely, and changed to allow every additional operating advantage. Extreme care has been taken in designing the mounting. Complete protection from the entrance of foreign substances into the bearing housing has been afforded. Ample space is allowed around the bearing for a sufficient supply of lubricant, and provision is made for forcing the lubricant through the bearing from one side to the other.

In no case does the maximum load and speed of the bearing selected exceed one-third of the manufacturer's rating. Aside from the reduction in friction loss, these blowers with anti-friction bearings offer new possibilities for direct connection to smaller motors with less horsepower to obtain increased capacities, operate with higher efficiency by permitting the use of more closely fitting cases, permit greater capacities with conservative speeds and deliver more volume with less horsepower.

STATEMENT BY THE SIMONS PAINT SPRAY BRUSH CO., DAYTON, O.

For use in connection with our paint spray brush, we have developed a line of portable air compressors. These units are made in various types, for semi-permanent use or for portable use, the latter type being mounted on wheels. Two types of drives are furnished, motor or internal combustion engine as desired. The motor driven unit is fitted with a ½-hp. motor which can be driven by a flexible connection from any lamp socket. When two brushes are to be operated simultaneously, a slightly larger type unit is furnished, driven by a 2-hp. gasoline engine.

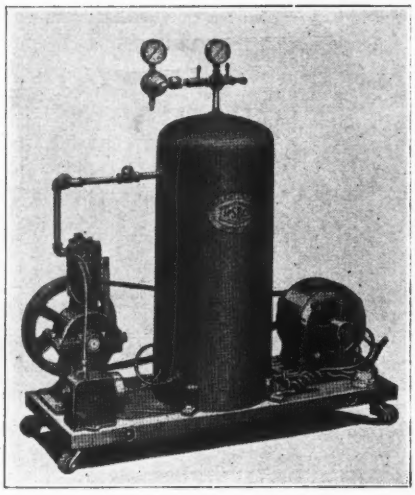


FIG. 6. SIMONS PAINT SPRAY BRUSH CO. AIR COMPRESSOR UNIT

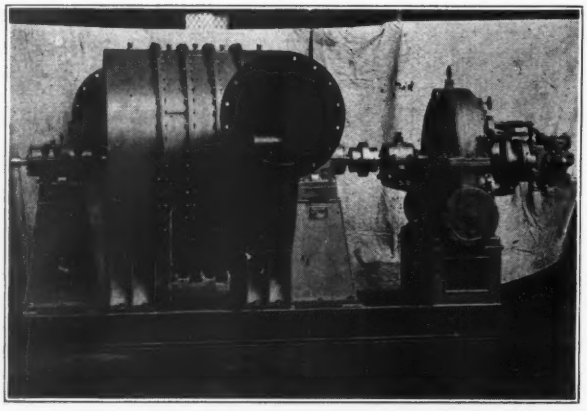


FIG. 7. B. F. STURTEVANT CO. MULTISTAGE CENTRIFUGAL COMPRESSORS

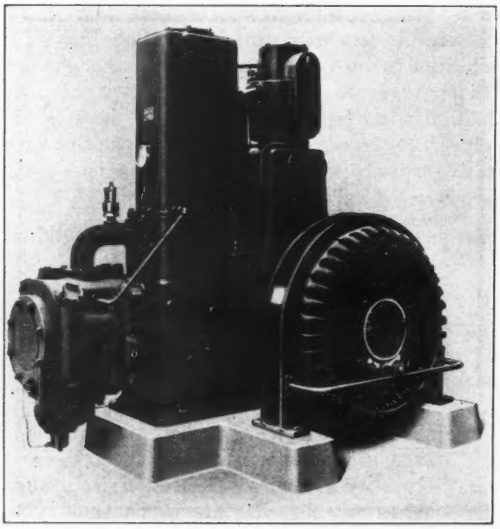


FIG. 8. SULLIVAN MACHINERY CO. DIRECT MOTOR DRIVER ANGLE COMPOUND COMPRESSOR

STATEMENT BY B. F. STURTEVANT CO., HYDE PARK, BOSTON, MASS.

Our line of Sturtevant Multistage Centrifugal Compressors has been brought out to handle a wide range in volume at pressures higher than can be obtained with ordinary centrifugal blowers. They are intended for direct connection to motors or steam turbines without the use of gears or belts. The construction is as simple as the ordinary fan and the higher pressures are obtained without recourse to excessive speed.

These compressors are used for furnishing air to gas and oil burners and all kinds of furnaces, for boosting pressures on illuminating and producer gas, for agitating water in filter plants and ice plants, pneumatic conveying systems and many other uses.

STATEMENT BY SULLIVAN MACHINERY CO., CHICAGO, ILL.

This company developed a new small sized angle compound air compressor during 1928. This machine has an 8-in. stroke and a capacity 313 to 418 cu. ft. of free air per min. It is built for working pressures of from 100 to 125 lb. This unit is notable for its small floor space requirements and for its adaptability to drive by long or short belt from motive power, or to direct connection to an electric motor, or to an oil or gas engine.

This unit places angle compound advantages of balance, relative freedom from vibration and multi-step load control at the disposal of the users who desire compressed air capacity within these smaller ranges.

Unique Devices for the Refrigeration Field

STATEMENT BY EDWIN BURHORN CO., BAYONNE, N. J.

FOR USE with comparatively small systems, we have developed the Burhorn Smaltower shown in the accompanying illustration. This is a cooling tower made up of steel frame with cooling devices so arranged

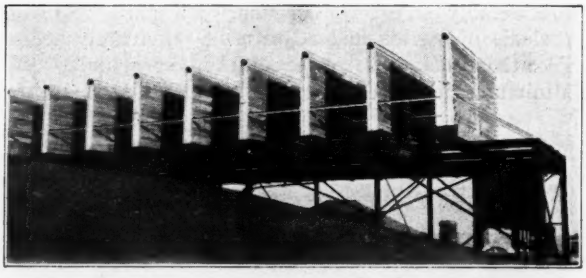


FIG. 1. BURHORN SMALTOWER FOR COOLING WATER

that the air has free access but will not permit water to be blown out of the system. The Smaltowers are made in sizes from a few gallons per minute up to 100 g.p.m. or more. A large system is made up of a sufficient number of units of the proper size. The usual spray pond is made up of nozzles having a capacity of 40 g.p.m. each. It is possible, therefore, to substitute for the nozzle a 40-g.p.m. Smaltower unit. The Smaltower unit is built from 8 to 12 ft. high so that the pumping head would be the same or less than that of a

spray pond. The Smaltower permits the water in circulation to be exposed to the prevailing air currents from 8 to 10 times as long as is possible with the spray pond.

No louver fence is required and there is no danger of water blowing out of the system.

STATEMENT BY THE FREDERICK IRON & STEEL CO., FREDERICK, MD.

While it is a little early to state that our new core sucking pump for ice plants will stand up indefinitely, so far all the reports on the operation of this pump that we have received have been highly favorable. It has proved very satisfactory.

A view of this pump is shown in the accompanying illustration. It is a single unit built for direct connection to an electric motor. With this pump, a certain amount of air can be handled with the liquid without interrupting the pumping. It is self-priming after the initial start and readily removes air pockets in the

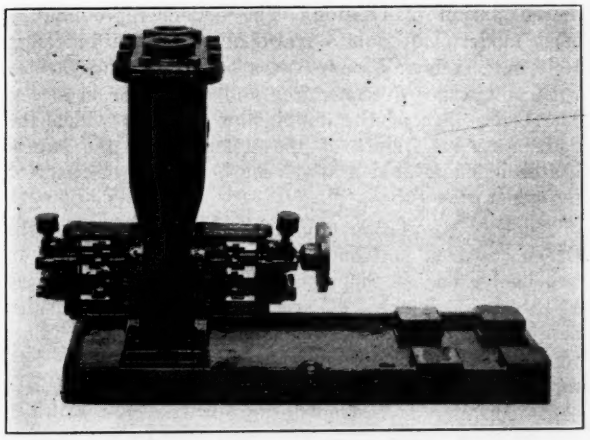


FIG. 2. FREDERICK CORE SUCKING PUMP

suction pipe. For this reason, it is more satisfactory than the centrifugal type pump when used for this purpose.

STATEMENT BY THE HILL CLUTCH MACHINE & FOUNDRY CO., CLEVELAND, O.

An interesting development with us this year embodying new principles of design and operation is the Hill Tubular Agitator. This agitator is a development and improvement of the Marine Propeller Type built by us 30 yr. ago for cement slurry. The marine propeller in the throat of the tube produces a downward or upward current without turbulence or eddy currents. The tube and bottom deflector control and direct the flow of the current so that the entire volume of the tank is in circulation and without dead areas.

Thorough and instantaneous intermixing takes place between the upward and downward currents through the tube slots. Deposits or precipitates are prevented from forming or are swept off of the bottom of the tank by the propeller wash. The unit mixes thoroughly. This is assured by the combination of circulating currents and intermixing without dead areas. The time required for agitation is low. Circulation and intermixing begin immediately with the propeller movement throughout the tank.

Power consumption is extremely low. Only skin friction in the tank and tube must be overcome. Power consumed by eddy currents, turbulence and churning of the propeller unit is saved. The agitator does not require constant operation. It will instantly pick up any precipitate deposit or sludge which has not solidified when the unit is idle. The mixture can stand for hours or days under such conditions and very quickly be brought to uniformity. This feature combined with the low horsepower required when operating makes it very economical.

It can be made to suit any circular tank. Structural steel frame work is ordinarily furnished to mount the

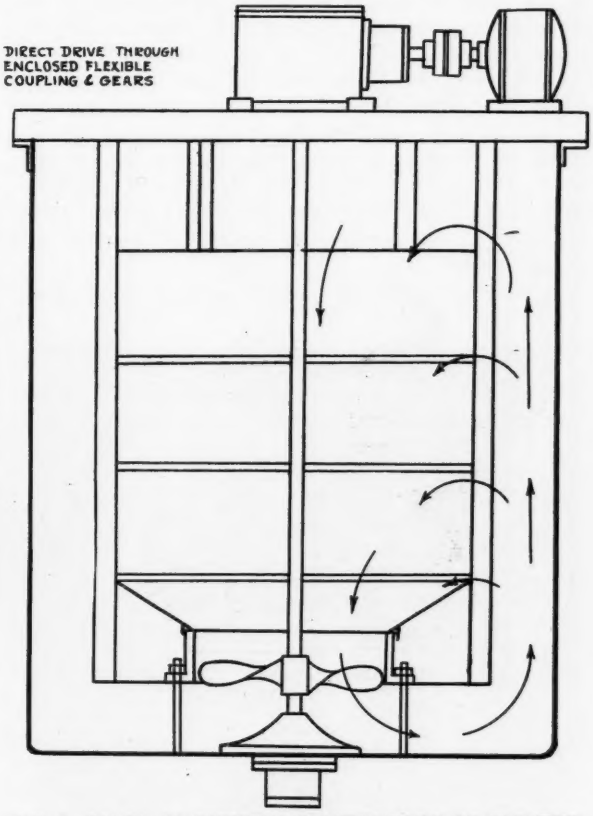


FIG. 3. DIAGRAM SHOWING CONSTRUCTION OF THE HILL TUBULAR AGITATOR

steel or wood tanks and when we furnish the tank the units are shipped completely assembled ready to operate.

STATEMENT BY THE VILTER MFG. CO., MILWAUKEE, WIS.

In reviewing developments made throughout the year, the most important achievement of this company was the development of the Vilter Super-Flooded System. In this type of installation for raw water ice making, the boiler type of tank coil has been employed, utilizing a completely flooded system. By such design, we have made it possible to utilize practically every square inch of coil surface, whereas, in the old type of continuous coil, a great deal of the coil surface was useless. In combination with a suction accumulator of the flooded type, the tank with the boiler type coils has shown difference between brine temperature and ammonia temperature of less than 2 deg. F., a fact which shows excellent efficiency not only in the matter of heat

transfer but in the matter of engineering. On the other hand, however, even with the great efficiency in the tank, the overall efficiency of the plant would be very poor were it not for the Vilter Super-flooded forecooler, a design of apparatus that goes hand in hand with the aforementioned tank in making up the super-flooded system.

Here the ammonia from the liquid receiver is expanded to a pressure corresponding to 33 or 34 deg. F. and an atmospheric type of forecooler coils cool the water for the ice cans to less than 35 deg. before piping to the can filler. Not only is the water forecooler so arranged a great adjunct to the system but also it acts as an ammonia forecooler, giving each pound of ammonia circulated in the ice tank coils a greater refrigeration content. Perhaps the greatest single item of importance of the Vilter Super-Flooded System is the Float Tank Regulator which maintains the proper level of ammonia in the forecooler and permits a definite quantity of ammonia to be expanded in the ice tank coils. By means of this regulator, the entire system is so balanced that scarcely any attention need be paid to the plant during operation save normal inspections and adjustments.

Vilter has marketed another excellent piece of apparatus known as a forced draft air cooler during the past year. In this air cooler, there are a number of loop coils of a welded type construction supplied with suction and liquid headers and a regulating device which permits the ammonia to maintain an equal level in all loop coils. Forced draft is supplied by an aeroplane propeller type fan and the blast of air is sufficient to give ample circulation through a large room. These coolers have found extended application in fur vaults, butcher boxes, fruit and meat storage rooms and similar installations where formerly overhead coils furnished the refrigeration. Because of the high velocity of the air passing through the loop coils, the rate of heat transfer is increased to an extremely high point so that a small surface coilage is sufficient to provide considerable refrigeration.

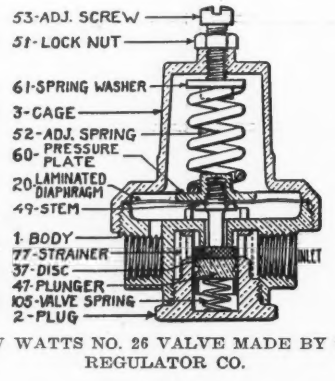


FIG. 4. NEW WATTS NO. 26 VALVE MADE BY THE WATTS REGULATOR CO.

During the year, Vilter has supplied a number of carbon dioxide plants which have been entirely successful, not only for theater use, but in hotels and other installations. Here again multiple effect has found considerable favor and permits a higher overall efficiency of the plant than is possible with the use of single compression.

STATEMENT BY THE WATTS REGULATOR CO., LAWRENCE, MASS.

A recent development of this company which has met with extraordinary success in the refrigerating field is the new Watts No. 26 valve shown in the accompanying illustration. This is a reverse acting water pressure reducing valve with a strainer incorporated in the valve. It is fitted with a laminated diaphragm acting against a powerful spring, the latter being easily adjusted by means of an adjusting screw at the top of the cage. The valve is of the straight way type to conform to our new straightway line of valves for all kinds of water and air service.

A Modern British Boiler Installation

INTERESTING FEATURES are embodied in two Yarrow water-tube boilers, installed at the Bankside power station in London. The boilers represent the most modern up-to-date stationary practice in Great Britain. Each unit comprises a boiler and superheater with a superposed economizer and air heater in series. The boilers are of the double-flow type, in which the gases pass both sides of the steam drum, the superheater being located at the rear between two nests of the generating tubes.

In this installation, the economizer, which is of the Green cast-iron horizontal tri-tube type is arranged in two banks, one at the front and the other at the rear of the steam drum. A Yarrow tubular-type air heater mounted above the economizer is designed for the gases to pass vertically through its tubes, the air for the furnace passing horizontally round the outside of the tubes.

On the fan floor are a forced-draft and a Keith & Blackman induced-draft fan, and it also supports a steel chimney. The induced draft fan is of the double-inlet type with a damper arranged in each inlet. Gases leaving the front and back of the boiler are suitably proportioned to the fan inlet by dampers. The operation of the dampers enables the amount of gases passing the back of the boiler to be varied, thereby giving control over the final steam superheat temperature.

This construction provides for a large combustion chamber, with a great amount of boiler heating surface exposed to the furnace. Two Bennis stokers, 8 ft. wide by 18 ft. long, are provided. The following are the principal particulars of each unit: Generating heating surface, 9700 sq. ft.; superheating surface, 2000 sq. ft.; economizer surface, 1880 sq. ft.; air heater surface, 8700 sq. ft., and grate area, 290 sq. ft. Results obtained at the official trial tests are summarized, as follows: Water evaporated per hour, actual 62,907 lb., from and at 212 deg. F., 78,500 lb.; working pressure, 262 lb. per sq. in.; steam temperature, 613 deg. F.; feed temperature, 149 deg. F.; coal burned per hour, 7694 lb.; mean CO_2 at chimney base, 12.7 per cent; temperature of gases at chimney base, 383 deg. F.; mean air temperature under grates, 345 deg. F. The gross overall efficiency, based on the gross calorific value of the coal, was 83.1 per cent; the net overall efficiency, based on the net or lower calorific value of the fuel was 87 per cent.

INSTRUMENTS AND FLOW METERS

Indicating and Recording Instruments

STATEMENT BY THE BAILEY METER CO., CLEVELAND, O.

THE BAILEY METER CO. is now in a position to supply equipment for recording and indicating pressure, temperature, draft, liquid level and other factors at practically any distance from the source. In fact, any condition which can be measured can be recorded and indicated at the desired distant point through the use of the mechanism now made available by this company. Positive and accurate transmission of measurement is assured.

Elements used for measuring pressure and temperature at the source are standard equipment, having been in service in power plants for years. For the transmission of the measurements, the Selsyn motor is used. This is the device which has for some time been in service on battle cruisers, for the direction of gun fire from the bridge and in practically every central station for the transmission of signals from the control room

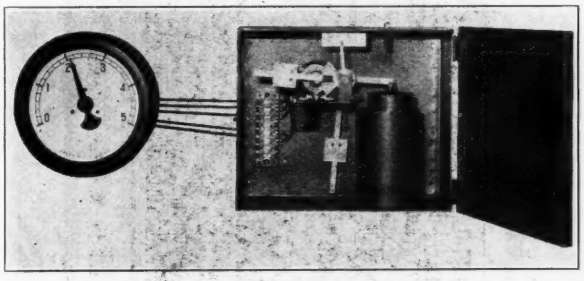


FIG. 1. A NEW REMOTE INDICATING DRAFT GAGE OF THE BAILEY METER CO.

to the operators. A unit for indicating draft is shown in Fig. 1.

The Selsyn system consists fundamentally of a Selsyn motor and a Selsyn generator which are in some respects like three phase induction motors but have shuttle-wound rotors with definite poles whose windings are connected through slip rings or flexible leads, depending upon the type of construction, to a single phase, alternating current source of excitation. Their stators are inter-connected electrically.

Commonly, the generator is called the transmitter and is rotated by the device measuring the factor to be transmitted. The motor is installed at the remote point and is connected to the indicator or recorder.

When the supply circuit is closed, an alternating voltage is impressed on the rotors and as the motor or receiving rotor is free to turn, it takes a position corresponding to the position of the generator or sending rotor; and if the sending rotor is turned, the receiving rotor follows at the same speed and in the same direction.

The reason for this synchronous operation is that the single-phase current in the rotors induces voltages in the three legs of the stators. The three voltages are unequal and vary with the positions of the rotors. When the receiver rotor is in exact correspondence with the transmitter rotor, the voltages induced in the receiver stator are equal and balance the voltages induced in the transmitter stator so that current does not flow in the stators.

If the receiver is restrained from assuming the same position as the transmitter, the induced voltages are no longer equal and balanced, and current flows in the stator circuits. This current reacts upon the rotors and sets up a torque which tends to bring them into agreement. If the transmitter is held, the torque reacts

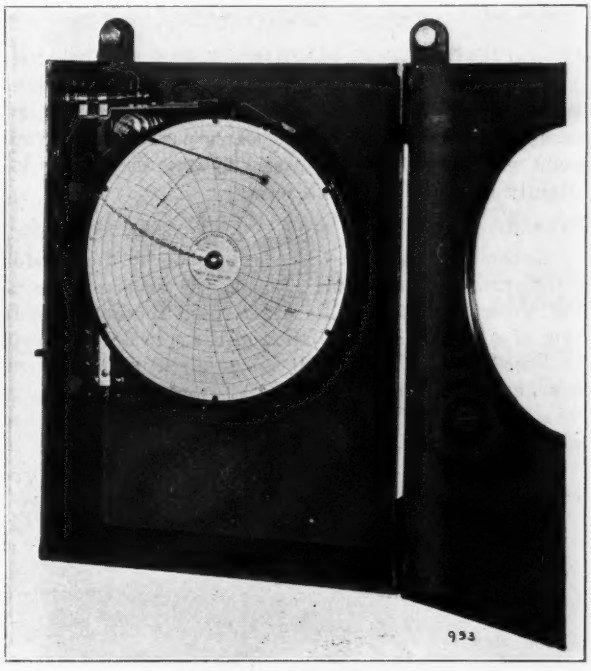


FIG. 2. SPECIAL BAILEY LIQUID LEVEL RECORDER

against the force which restrains the receiver, thereby tending to bring it into correspondence with the transmitter.

Selsyns are exceptionally accurate because of the shuttle-wound rotors, careful balance of electrical and mechanical parts and low friction ball bearings. The receiver responds immediately to the position of the transmitter. There is no hesitation in starting. The transmitter moves and the receiver follows instantaneously. If power fails, the receiver automatically resets in agreement with the transmitter on resumption of power. Several receivers may be operated from the same transmitter.

We have also developed the meter shown in Fig. 2, a specially constructed liquid level recorder used on a 25,000 gallon water tank. The mechanism is designed to give a record of water level on a 12 in., 24 hr., circular chart and also operates mercoid switches to sound alarms at predetermined maximum and minimum water

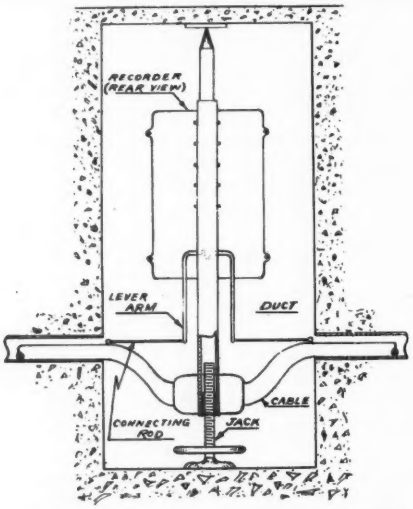


FIG. 3. INSTALLATION DIAGRAM OF THE BRISTOL MECHANICAL MOTION RECORDER

levels. In addition, mercoids are operated to start pumps to fill the tank as the water passes the ¾ full point on a decreasing level and to stop the pumps at slightly less than full tank level.

STATEMENT BY THE BRISTOL CO., WATERBURY, CONN.

Considerable progress has been made by the Bristol Co. during the past year. Among the developments is the Mechanical Motion Recorder, used to show expansion of cables. The installation of the recorder is shown in Fig. 3. This instrument is equipped with two pen arms and two lever arms. The lever arms are attached to a cable as shown and movement of the cable from its original position is recorded on the chart.

Other new developments are the differential recorder shown in Fig. 4 and the new 4-in. model

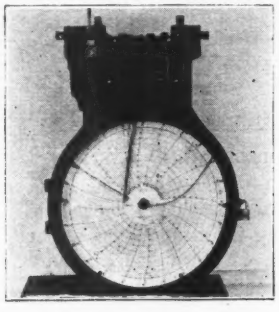


FIG. 4. NEW BRISTOL DIFFERENTIAL RECORDER

portable thermometer shown in Fig. 5. The all metal case is light in weight and the standard finish is black enamel.

STATEMENT BY THE BURGESS-PARR CO., MOLINE, ILL.

The Burgess-Parr Co. Recording Gas Calorimeter is a development of several years of research conducted by Professor S. W. Parr and his associates. It is a continuous, recording calorimeter of the flow type, in which water is used as the medium for absorbing heat produced by combustion of the gas. Measurement of the gas and water is exact and automatic, and the calorific value of the gas is automatically recorded by a standard temperature differential recording instrument.

Development of this calorimeter, Fig. 6, has proceeded in the laboratory of Burgess-Parr Co. at Moline,

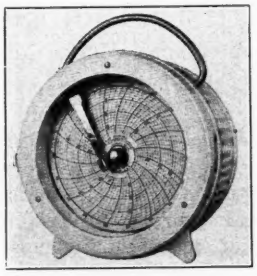


FIG. 5. PORTABLE BRISTOL THERMOMETER

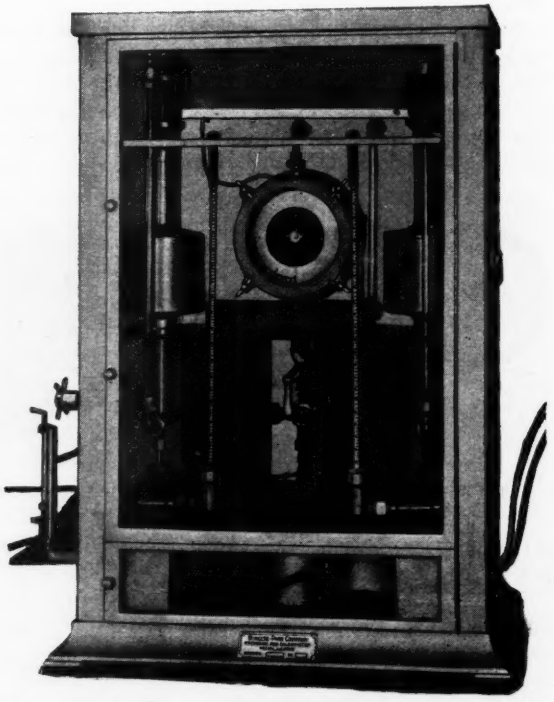


FIG. 6. RECORDING GAS CALORIMETER RECENTLY DEVELOPED BY THE BURGESS-PARR CO.

Ill., and it is expected that commercial production will commence early in 1929.

STATEMENT BY THE ELECTRIC TACHOMETER CORP., PHILADELPHIA, PA.

Wherever a small and inexpensive alarm for over or under speed is required, the Tetco Centrifugal Switch developed by The Electric Tachometer Corp. can be used. This switch is shown in Fig. 7.

It is useful on water wheels, hoists, pumps, blowers or turbines where unexpected changes in load or changes in power supply would cause abnormal speeds.

Its simplicity, ease of installation and low cost make it suitable for installations where expensive built-in governors or automatic regulators would not be justified.

The contacts have sufficient capacity to light lamps or operate small motors. Several arrangements of contacts for over-speed or under-speed can be provided.

STATEMENT BY JULIEN P. FRIEZ & SONS, BALTIMORE, MD.

To record and indicate at a distance the water levels of forebay and tailrace of hydraulic plants Julien P. Friez & Sons manufacture the Au water level recorder and indicator, one model of which is shown in Fig. 8. The recorder is placed over the water level to be measured while the indicator is placed in the operating

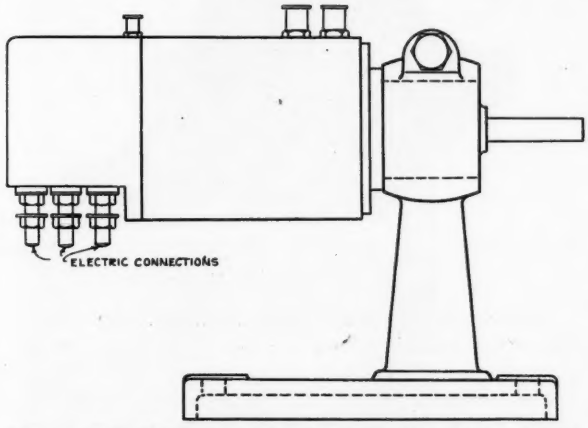


FIG. 7. THE NEW CENTRIFUGAL SWITCH OF THE ELECTRIC TACHOMETER CORP.

room. Another type uses only a transmitter over the water level with the indicator placed as desired.

STATEMENT BY THE LIQUIDOMETER CO., INC., LONG ISLAND CITY, N. Y.

A new line of direct reading gages which can be installed directly on the tank and read at the tank rather than at some distant point has been brought out by the Liquidometer Co.

These gages are constructed throughout of the best materials, and will give long and accurate service. The two types of direct reading gages to be built are the horizontal type which is installed in a casement flange and cover in the floor and which is intended principally for buried tanks. There is also the vertical type which is suitable for installation on tanks above ground, where the reading of the tank can be taken by merely looking on the dial located on top or in the side of a tank.

These gages are direct mechanical ones in contrast to the hydraulic principle which is used in our distance reading gage.

STATEMENT BY THE PERMUTIT CO., NEW YORK, N. Y.

A Ranarex density recorder, Fig. 9, which operates on the same basic principle as the Ranarex CO_2 recorder has been developed by the Permutit Co. When gas is metered by means of an orifice meter, it is necessary to know the specific gravity of the gas in order to determine the quantity passed through the meter. In such cases, the Ranarex gas density recorder will be found very useful. The practice of mixing different types of gases is coming more and more into use. Variations in the specific gravity of the mixed gas are undesirable since they interfere with satisfactory operation of the gas burners. Such variations can immediately be detected and therefore prevented in time by the use of a Ranarex density recorder.

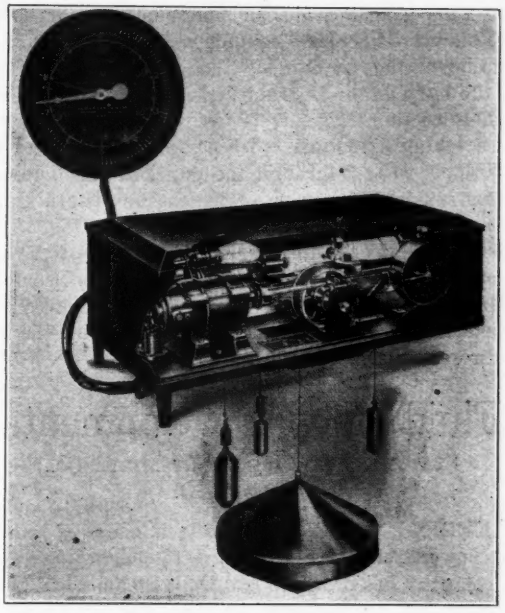
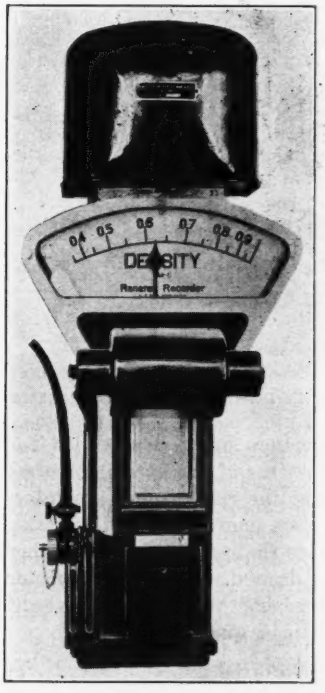


FIG. 8. THE AIR WATER LEVEL RECORDER AND INDICATOR AS MANUFACTURED BY JULIEN P. FRIEZ & SONS

STATEMENT BY THE TAYLOR INSTRUMENT COS., ROCHESTER, N. Y.

A new style mercury column vacuum gage, shown in Fig. 10, has been brought out by the Taylor Inst.



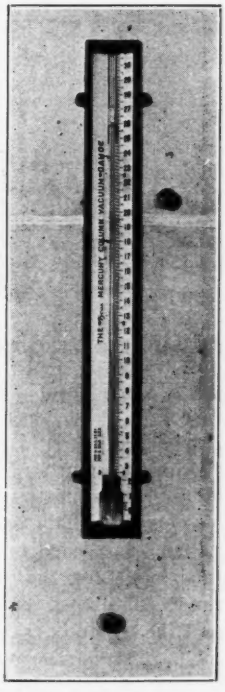


FIG. 9. RANAREX DENSITY METER OF THE PERMUTIT CO.
FIG. 10. NEW TYCOS FLUSH MOUNTED MERCURY COLUMN

Cos. This gage operates in the same manner as any other standard mercury column vacuum gage but it is so designed that it can be flush mounted, that is to say, the body of the instrument is set back of the panel.

In a vacuum gage, it is necessary to set the zero before taking a reading; to accomplish this, there is a knob that projects through the panel at the bottom of the instrument, by means of which the cistern can be raised or lowered to make a correct zero setting. There is also a knob at the upper right-hand side of the gage for operating the vernier. The gage can be furnished optional with or without a vernier. An engraved thermometer is mounted on the scale to indicate the temperature of the mercury column.

Fluid Meter Developments

STATEMENT BY THE BAILEY METER CO., CLEVELAND, O.

KEEPING STEP with the tendency of modern power plant design toward the higher pressures, this company has designed and built Steam Flow Meters for operation on pressures up to 1500 lb. per sq. in. For development purposes, one of these meters has been in satisfactory operation over a period of close to four years while several more have been in operation nearly a year.

STATEMENT BY THE BROWN INSTRUMENT CO., PHILADELPHIA, PA.

With high pressures becoming standard steam practice, forged steel fittings become urgently necessary. In step with these advanced requirements come The Brown Inst. Co. forged steel high-pressure manometers for use with Brown Electric Flow Meters. Hammer forged from bar stock, individually tested to 1500 lb. pressure,

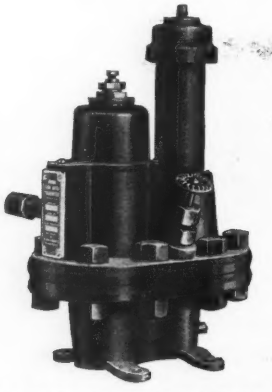


FIG. 1. THE NEW BROWN FORGED STEEL MANOMETER

Brown forged steel manometers are recommended for all pressures up to 750 lb. One of the special features of these manometers is that the range tubes are interchangeable. This is an easy, inexpensive adjustment. All that is needed to replace the range tubes is another tube made for the range desired. Brown flow meter range tubes cost little, the labor of changing is slight and the whole operation can be quickly performed.

STATEMENT BY THE BUFFALO METER CO., BUFFALO, N. Y.

For many years past, the importance of accurate, reliable measurement of heated water supplied to steam boilers has been appreciated by power plant engineers but the use of hot water or boiler feedwater meters has not been as great as it might be. This has been due to inability of the average hot water meter to withstand all the conditions of operation to which it might be subjected in power plant use. It has been a characteristic of hot water meters that they could not be operated over a very wide range of flow and that if a little steam got into the meter occasionally this would race the measuring element, damaging it.

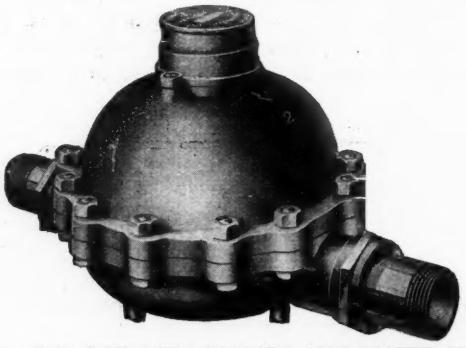


FIG. 2. THE IMPROVED NIAGARA HOT WATER METER OF THE BUFFALO METER CO.

After several years' experimenting, the Buffalo Meter Co. has placed on the market during the past year an improved type of mechanism in its Niagara hot water meters, shown in Fig. 1. This new improvements allows the meters to be operated at a greater flow and over a much wider range of flow than was formerly possible. It also prevents damage to the measuring unit if steam gets into the meter, though it is still recommended that the meters be protected against steam so far as possible, due to the errors in reading which would be introduced by the increased volume of steam as compared with water.

This improvement has been made by a change in materials, rather than the addition of any new parts. The construction of the meter is not complicated in any way, nor the price increased. It has proved remarkably successful in all power plants where it has been tried and the indications are that it makes possible a decided increase in the use of automatic measuring devices for recording the amount of hot water supplied to boilers or used for any other purpose where hot water must be measured.

STATEMENT BY THE COCHRANE CORP., PHILADELPHIA, PA.

The Cochrane V-notch Recorder is a complete instrument for indicating, recording and integrating the rate of flow over a V-notch or other form of weir has been developed by the Cochrane Corp. The indicating, recording and integrating members are driven directly from the float without slack or backlash so that rapid movements of the float cannot cause disarrangement. The pen inscribes upon a chart having uniformly spaced graduations, while the pointer traverses a uniformly divided scale. All of the digits of the counting train except unity advance by whole numbers. The complete mechanism is supported by one casting removable as a unit from the case, and dust proof. It is mounted on a pedestal permitting of quick set-up and rotation to

face in any direction. The single clock drive may be either of the two-spring type or an electric clock which does not require winding. Standard cams are available for standard Cochrane V-notches, but special cams will be cut to fit any form of weir of which the characteristics are given.

During the past year, the Cochrane Deaerating heater has been supplied in many cases fitted with a V-notch meter as were the standard Cochrane heaters, which were then known as metering heaters. The new type recorder referred to above is of great advantage as is also a special outside float box which has been developed for use therewith. This float box connects to the still water chamber of the V-notch meter by a high narrow channel which insures absolute equality of water level at all times while keeping the water in the

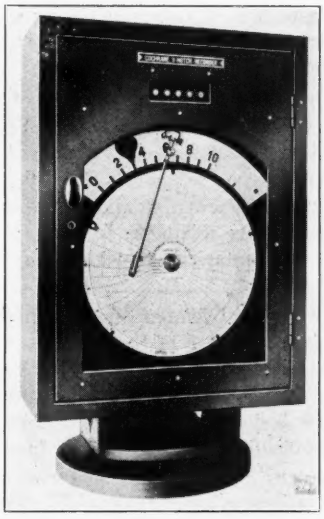


FIG. 3. COCHRANE V-NOTCH RECORDER

float chamber somewhat lower in temperature than the water in the meter, so that the water in the float chamber does not flash and throw the float up in case there is a sudden reduction of pressure in the heater.

We have found that this device eliminates many troubles formerly experienced with metering heaters where there were rapid changes in the rate of flow of cold water or in the rate of supply of steam and it is particularly useful in connection with the deaerating type of heater which is generally subject to a varying heat balance in volving continual shifting of the temperature and pressure in the apparatus.

STATEMENT BY THE FOXBORO CO., FOXBORO, MASS.

To meet the demand for accurate steam flow meters, The Foxboro Co. has built an instrument the design of which is based on that of the Foxboro Orifice Meter which has been extensively used for many years for the measurement of gas flow under field conditions where a rugged simple mechanism of high precision is necessary.

The instrument is calibrated to read and record in terms of flow and is equipped with an integrator that reads direct without multipliers, the total pounds of steam that have passed through the pipe. The Integrator is a simple, accurate, dependable mechanism driven by an electric clock, or a spring-wound clock if preferred. Once each minute, it adds on the counter the number of pounds of steam that have flowed through the pipe during that minute. For example, if steam is flowing at a rate of 56 lb. per min., the Integrator will add 56 to the total indication of pounds of steam. The chart reads direct in pounds per hour.

This new meter is fundamentally accurate because it is of a simple mechanical design in which friction is reduced to a minimum and a large, powerful float is employed, the motion of which is transmitted without angularity (Harmonic motion), and because the steam coefficients were carefully determined by the company after extensive research and experimentation covering a period of years. This program of research included a complete series of steam flow tests at the Massachusetts Institute of Technology.

The new meter is a single unit. It has no electrical devices, special compensators, balances or stuffing-boxes and requires no maintenance except to change the chart and ink the pen.

STATEMENT BY THE MERIAM CO., CLEVELAND, O.

For low pressures, The Meriam Co. has, as an accommodation, furnished its Type "E" indicating flow

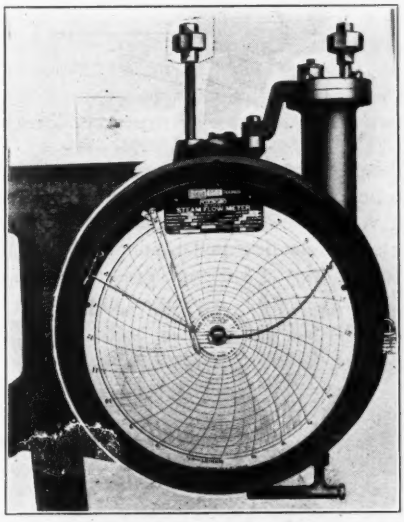


FIG. 4. FOXBORO STEAM FLOW METER

meter with threaded piping, steel needle valves and unions, all connected ready for service connections to inlet and outlet.

For high pressures, this method of connecting was not always satisfactory and after considerable experimental work, it was decided to make meter, piping, valves and unions one solid unit.

This was accomplished by installation of the new atomic hydrogen welder. With this method of welding the connections, the user is assured of a non-leaking unit, starting at the inlet and outlet connections and ending at the glass tube connections; non-leakage at the latter assured by the new glands of monel metal and the improved method of packing.

The Meriam Type "E" indicating flow meter is suitable for accurately measuring the flow of air; any gas; saturated or superheated steam; oils and other liquids at any temperature, any pressure or vacuum.

STATEMENT BY THE P. H. & F. M. ROOTS CO., CONNERSVILLE, IND.

In addition to the important improvements in mechanical design incorporated by The P. H. & F. M. Roots Co., in the New Roots Meter, desirable changes

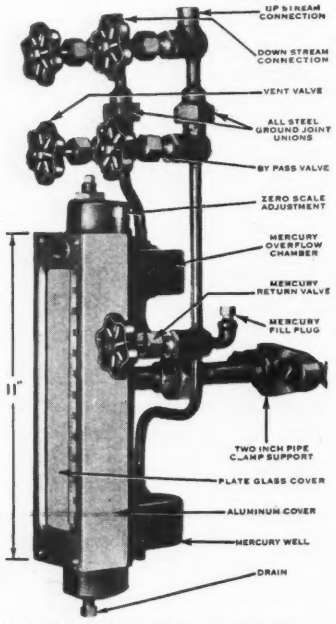


FIG. 5. THE MERIAM TYPE E INDICATING FLOW METER

in operating characteristics have been accomplished. The reduction in running friction brought about by the improved volume integrator, timing gear set, bearing mounting and recording instrument drive, has not only reduced the amount of slippage present but has affected the relationship of this slippage quantity to the total volume measured.

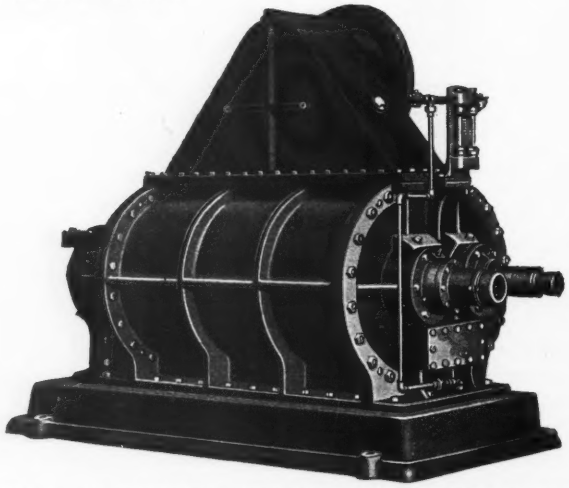


FIG. 6. AN EXTERIOR VIEW OF THE NEW ROOTS METER MODEL 5A

This changed relationship practically eliminates the necessity of manual correction for slippage on the registered volume. The degree of accuracy obtained by the use of volume readings taken directly from the integrator is well above that universally accepted by the industry.

In order to meet diversified requirements, this metering equipment is built in a large number of sizes with hourly capacities ranging from 100 to 1,000,000 cu. ft. per hr. These capacities are based on atmospheric displacement and may be increased by raising the pressure of the gas being metered and correcting the displaced volumes to standard temperature and pressure conditions.

To make these meters thoroughly adaptable to present-day measurement needs, a complete line of recording instruments have been developed. Through standardization of these instruments, it is now possible to interchange them on any meter, regardless of the latter's size.

Two styles of the New Roots Meter, the Standard Duty and Heavy Duty types, are offered. The first is for gas measurement where pressure requirements do not exceed 10 lb. per sq. in. The Heavy Duty Meter is adapted for service where pressures up to and including 100 lb. per sq. in. are considered.

Each meter is equipped with a Roots volume integrator and a Roots differential gage. Special recording instruments, including Roots distant volume integrator, Roots-Tripo recorder, Roots-Quad recorder, Roots metergraph, Roots demand recorder and Roots flow rate recorder are available for the special requirements of any particular use to which they may be put.

Where the size and temperature of the furnace walls are limited, as in the case of Scotch marine boilers, it is necessary to have very fine pulverization; otherwise, the problem of maintaining ignition and completing combustion is serious. With larger furnace volume, lower rates of combustion and hotter furnaces, coarser coal can be burned satisfactorily so far as the completeness of the combustion is concerned.

Finely pulverized coal ignites more readily than coarse coal and the percentage of volatile has an appreciable influence on the ignition temperature. For instance, coal of a certain fineness with 35 per cent volatile has an ignition temperature of about 1300 deg. F., while coal with the same fineness but with 5 per cent volatile has an ignition temperature of 1600 deg. F.

For best conditions, the furnace must supplement the burner. In other words, after every improvement has been made in the means of feeding the coal to the burner and in the burner design itself, the shape, size and temperature of the furnace must be properly adapted to the fuel being burned. Also the fineness and dryness of the coal must be further adapted to any limitations that may exist in the furnace itself. The trend in burner design is to shorten the flame and complete the combustion in a minimum of space and flame travel. Therefore the furnace size can be reduced and further savings made in the size of the building.

In designing furnaces, especially where ash of low fusing temperature is to be burned, one other item in addition to those already mentioned must receive careful consideration, and that is the removal of ash from the furnace. Part of this ash goes to the ash pit while the remainder passes out through the boiler tubes. Removal of ash from the lower part of the furnace may be accomplished either in the dry or liquid state.—E. G. Bailey before the A. S. M. E.

New Electrical Meters

STATEMENT BY THE BRISTOL CO., WATERBURY, CONN.

AMONG the developments of the Bristol Co. is the triplex recording ammeter shown in Fig. 1. This is three recording ammeters mounted together in one case. It has received much attention and is being used by some of the more important public service companies.

Another item of interest is illustrated by Figs. 1B and 1C, the new rectangular case model 35 used for

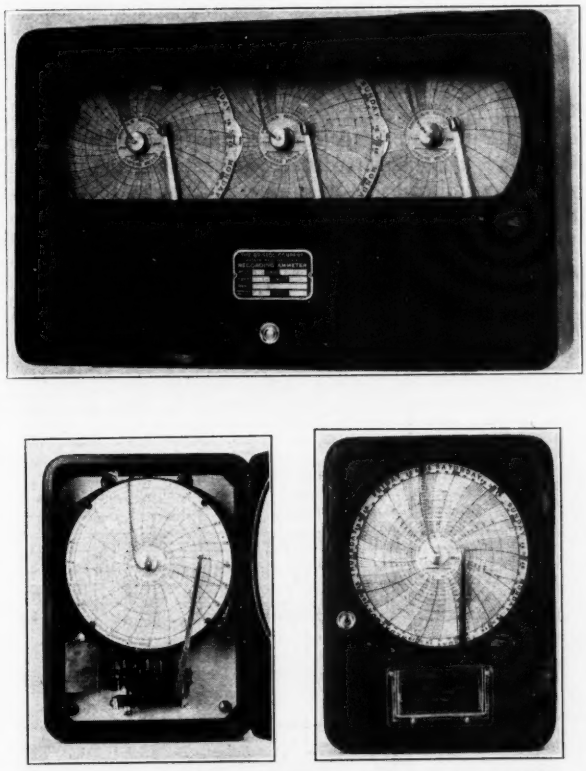


FIG. 1. BRISTOL DEVELOPMENTS, A. TRIPLEX RECORDING AMMETER, B. AND C. THE NEW RECTANGULAR CASE, MODEL 35

mounting voltmeters. This is furnished both for 8 and 6-in. chart sizes.

STATEMENT BY GEUDER, PAESCHKE & FREY CO., MILWAUKEE, WIS.

During the past year, pressed metal parts have been extensively applied to instrument cases, replacing heavy cast covers, bases and boxes with light, neat, rugged pressed metal parts. Figure 2 shows an instrument case now being made. This is an example of built up work and is not drawn seamless. The two heads are drawn seamless and then welded to the body.

STATEMENT BY THE ROLLER-SMITH CO., NEW YORK, N. Y.

Direct and Alternating Current Portable Instruments, the Roller-Smith Co. type SSD and SSA, are newly designed for laboratory use and to calibrate and check other instruments. These instruments, Fig. 3, are enclosed in steel cases and have dimensions of 8 in. by 8 in. by 4 in., not including binding posts. The scales are all hand calibrated and have a length of

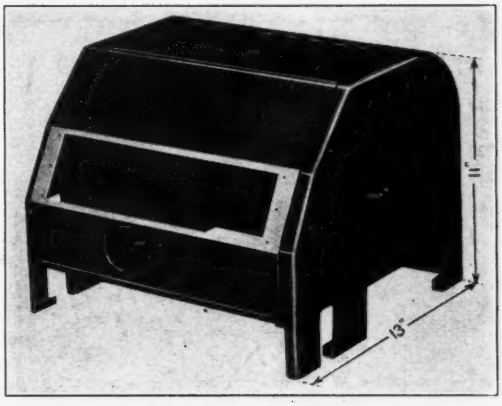


FIG. 2. PRESSED METAL INSTRUMENT CASE OF GEUDER, PAESCHKE & FREY CO.

6¾ in. All scales are equipped with mirrows which, together with the knife edge pointers employed, eliminate observational errors due to parallax. These instruments are regularly furnished in the alternating current line as ammeters, voltmeters, and milli-ammeters, and in the direct current line as ammeters, voltmeters, milli-ammeters, and milli-voltmeters.

The Type HEA-3 ammeter is a new three phase ammeter used by many public utility companies. The HEA-3 ammeter, Fig. 4, is distinguished by its very long scale (7⅛ in.) and is most useful when close readings are desired.

The Type HEA-3 ammeter consists of three horizontal edgewise mechanisms, mounted one above the other in a single case and utilizing one single window. The two outstanding features characterizing this design are as follows:

1. The ease with which accurate comparisons can be made of the current in three different phases. For simultaneous readings they cannot be equalled as the slightest difference between the current in the different phases is indicated clearly.

2. The relatively small switchboard area compared with the space occupied by three standard full size horizontal edgewise instruments.

The mechanisms are of the standard electro-magnet type. Damping is obtained through a damping vane rotating in a die-cast chamber. The three mechanisms are magnetically shielded from each other, so that there is no mutual interference. Base dimensions are 8⅜ in.

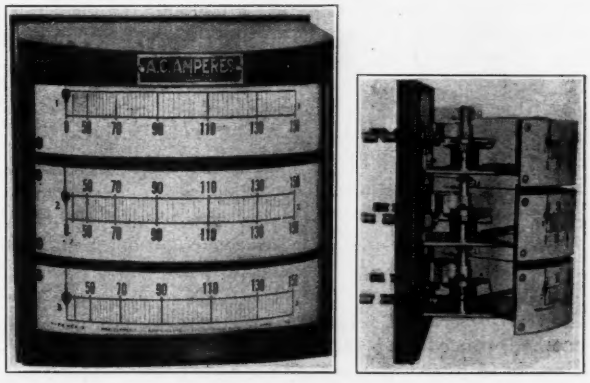


FIG. 3. ROLLER SMITH HEA-3 AMMETER THREE-PHASE INSTRUMENT

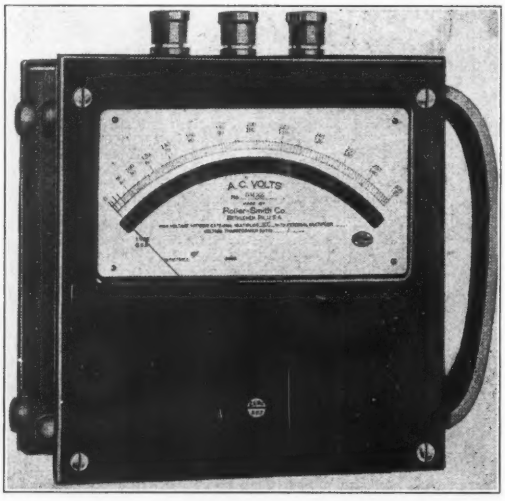


FIG. 4. THE NEW ALL METAL CASE ROLLER-SMITH PORTABLE INSTRUMENT

width and 9⅝ in. height and the case projects 6$\frac{29}{32}$ in. from the board. Connections are in the form of three pairs of rear studs firmly anchored to the base in bakelite bushings. The case is finished in dull black rubberoid finish. Dials are pure white bristol board with prominent black inscriptions, are well lighted and easily read. Scales are readable from about 20 per cent to 100 per cent of full scale value. The glass front is cemented in place. Accuracy is within 1¼ per cent of full scale value at any point on the scale.

This instrument is regularly furnished as a 5-amp. unit for use with current transformers having a 5-amp. secondary. The scale of the instrument is marked to agree with the primary current capacity of the transformer.

This company has also placed on the market a new line of a.c. and d.c. portable instruments, Fig. 4, which will be enclosed in steel cases. This not only protects the instruments to a maximum against damage due to severe service conditions, but also shields the mechanism from stray magnetic fields.

These instruments are offered in the a.c. line as voltmeters, ammeters, milli-ammeters, wattmeters, frequency meters, and power factor meters. In the d.c. line, they are offered as voltmeters, ammeters, milliammeters, and volt-ammeters.

The average size is 7 in. by 7 in. by 3¾ in. except for polyphase wattmeters, volt-ammeters, power factor meters and certain double range instruments, which are somewhat larger.

Determining Bearing Loads

ACCURATE DETERMINATION of loads to be imposed on ball bearings is necessary in order to secure satisfactory service in the most economical way. It is desirable that the whole design should be considered just as carefully as the stressing of other parts entering into the construction.

It is best for a given type of drive to use the same method, procedure and assumptions in each calculation, since a standard procedure, combined with experience on existing designs, facilitates intelligent selection.

It is rarely that the manufacturer's engineering department receives from a customer all of the data required in order intelligently to determine the loads imposed on bearings. As a usual thing, only about half the data really required is supplied and the engineering department has to write back for more information.

It is for this reason that the chart published in its house organ, The Dragon, was developed by The Fafnir Bearing Co. to show the information required to determine the load on bearings for various types of drives. The chart form is the most compact method of assembling the information because it makes possible the easiest, quickest reference by the bearing user. For example, to determine the data you should furnish the bearing manufacturer for a belt drive, simply read down the column headed "Belt" and note the squares which are left blank; when these are properly filled in, the chart will present a complete summary of the data required. Certain data, such as distance between centers, are required for all drives.

Conditions such as unbalance of rotating parts, vibration and load due to cutting tools cannot be accurately covered but should be estimated.

	SPUR	HELICAL SPUR	BEVEL	SPIRAL BEVEL	INTERNAL	HERRING BONE	WORM	BELT	ROPE	CHAIN	FRICTION
Shaft Size											
H. P.											
R. P. M.											
Engine Torque											
Drive Ratios											
Bearing Centers											
Pitch Diameter											
Diametral Pitch											
Circular Pitch											
Number of Teeth											
Number of Threads											
Tooth Form											
Spiral Angle											
Helix Angle											
Lead Angle											
Shaft Angle											
Bevel Angle											
Direction of Rotation											
Direction of Spiral											
Direction of Helix											
Direction of Thread											
Pulley Centers											
Sprocket Centers											
Belt Pull											
Rope Pull											
Chain Pull											
Belt Sag											
Rope Sag											
Chain Sag											
Pulley Diameter											
Sprocket Diameter											
Diameter of Rope											
Fly of Belt											
Number of Ropes											
Contact Pressure											
Form of Groove											
Type of Chain											

DATA REQUIRED FOR BEARING LOAD CALCULATIONS

It is recommended that layouts of the proposed design with the required dimensions filled in and accompanied by the other necessary data indicated in the chart be submitted with all requests for recommendations. With such data, a detailed calculation sheet showing the load on each bearing and the bearing recommendation can be submitted to the customer. In this way, the customer is assured of a correct recommendation and one which the bearing manufacturer can guarantee.

ELECTRIC TRANSMISSION AND USE

Self-Ventilated Motor Marks Motor Progress

STATEMENT BY FAIRBANKS, MORSE & CO., CHICAGO, ILL.

ONE OF OUR important motor developments of the latter part of last year which has continued into this year is the enclosed self-ventilated motor with air-cleaning feature. The range of ratings of this motor has been extended and they have already been installed in several thousand industrial applications. In automotive service alone, more than 2000 of these motors have gone into service in Detroit plants. A sectional view of this motor is shown in the accompanying illustration. Air entering one end of the casing under the action of the fan blades on the rotor is deflected through a sharp angle at the top of the casing causing the dirt particles to be thrown out through an opening in the top.

STATEMENT BY THE LOUIS ALLIS CO., MILWAUKEE, WIS.

Two significant accomplishments were made by the Louis Allis Co. during 1928 in developing enclosed motors of reasonable size. These are the explosion-proof self-ventilated motor for use in explosive atmospheres; and the enclosed self-ventilated motor for applications involving less hazard but requiring a fully enclosed motor. These developments, together with "Resistallis" protective coating for the windings of open motors, fill industry's need for motors of reasonable size suitable for applications involving various degrees of hazard either to the motor winding or the surroundings. To machinery manufacturers, the outstanding advantages of these three types of protected or enclosed motors is that they are small enough for mounting direct on the driven machine. These motors enable the manufacturers to adapt standard machines, built to accommodate standard motors, to hazardous and semi-hazardous industries. The features of the three types are noted briefly below.

EXPLOSION-PROOF MOTOR

Fully enclosed and self-ventilated. Tested and listed by Underwriters' Laboratories for use wherever gasoline, or liquids of equivalent or less hazard such as

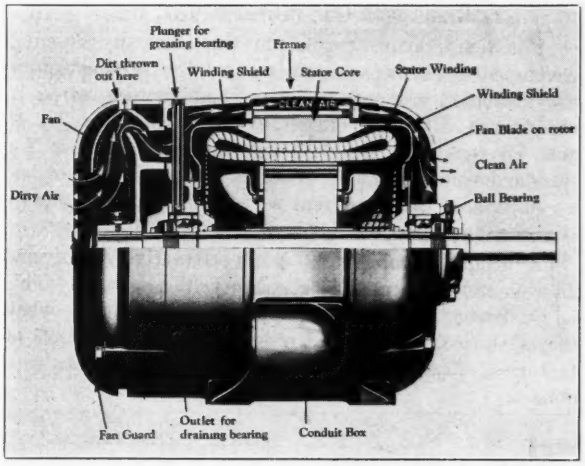


FIG. 4. FAIRBANKS, MORSE & CO. ENCLOSED SELF-VENTILATED MOTOR

other petroleum products, ethyl alcohol, methyl alcohol and acetone, are made, used or handled. When direct connected to machines in explosive atmospheres, thus eliminating belts, this motor eliminates the serious hazard of fire from sparks due to belt static. This motor is only slightly heavier than an open motor of same capacity—can be installed in same space—and is interchangeable in mounting dimensions.

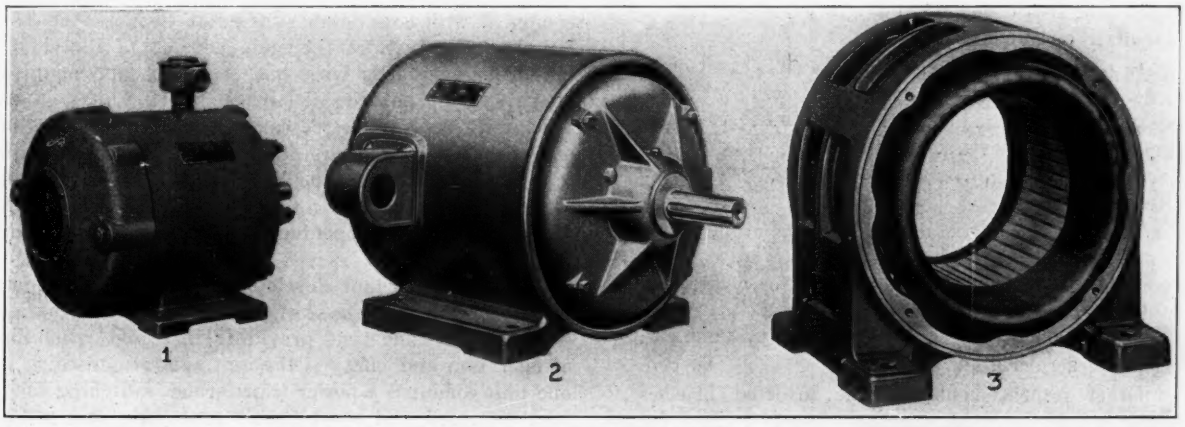


FIG. 1. LOUIS ALLIS CO. EXPLOSION PROOF SELF-VENTILATED MOTOR. FIG. 2. ENCLOSED, LOUIS ALLIS SELF-VENTILATED MOTOR. FIG. 3. STATOR OF MOTOR PROTECTED WITH LOUIS ALLIS RESISTALLIS COATING.

Fully enclosed and sealed against excessive dust, moisture, oil, acid, alkali, fumes and other foreign matter. Cooled by the surrounding air forced through outer shell over surface of enclosed motor frame. Clean air is not required. There are no pipe connections or air ducts. It is only slightly heavier than an open motor, installed in the same space and interchangeable in mounting dimensions.

"Resistallis" coating protects windings of open motors and makes them suitable for installations where considerable quantities of organic dust, iron dust, moisture, acid, or alkali are present. "Resistallis" entirely covers coil ends and slots, is not affected by temperature and does not affect ventilation; it makes a standard motor suitable for reasonably severe duty without added cost.

STATEMENT BY THE MINNEAPOLIS-HONEYWELL REGULATOR CO., PHILADELPHIA, PA.

For temperature regulation this company recently developed a line of electric motors for application to low and high-pressure valves. These motors, rated in accordance with their input, were classified as 25, 40 and 75 w. Only single-phase induction motors for standard voltages and frequencies are available now but a comparable direct-current series for the same service is under development.

A unique arrangement is an attractively designed 25-w. motor connected to a steam radiator valve. This is an exceedingly useful application and can, when thermostatically controlled, regulate the temperature of factories, offices, apartments and rooms of private residences.

Switching Equipment Undergoes Further Refinement

STATEMENT BY THE CONDIT ELECTRICAL MFG. CORP., BOSTON, MASS.

DURING THE PAST year, this company has brought out many new developments, some of which are of such a character as to be considered a distinct advance to the industry. Of particular interest is the new line of indoor switchboard and station type oil circuit breakers, consisting of types 4-123, D-118, D-128, D-117, D-131 and D-127, and the indoor heavy-duty type F-120 line of oil circuit breakers.

In these breakers have been applied certain new features which recent research and field interrupting capacity tests have proved of exceptional value in increasing the interrupting ability of the oil circuit breaker, while at the same time greatly prolonging its life.

These features include very large arcing contacts whose thermal absorption capacity materially reduce the temperature and duration of the arc on interruption and an arrangement of the arcing contact system which utilizes the short circuit current to provide electromagnetic acceleration.

Other improvements include inverted brushes to withstand high inrush currents; massive, rigid frames with new tank lands affording a more effective seal against oil throwing; oversize, one-piece, wet-process porcelain bushings extending well below the oil line, especially designed mechanically to withstand the impacts of high inrush currents.

The D type breakers are furnished for 400, 600, 800 and 1200 amp. at 15,000 v. and 1600 amp. at 7500 v. with the following estimated interrupting capacities at 15,000 v.; type D-123, 2700 amp.; type D-118, 3500 amp.; type D-128, 5000 amp.; type D-117, 6000 amp.; type D-131, 7000 amp.; type D-127, 8000 amp.

Type F-120 line of heavy-duty breakers are furnished for 600, 800, 1200, 1600 and 2000 amp. at 15,000 and 25,000 v. on the standard N.E.L.A. and N.E.M.A. interrupting capacity steps up to 1,500,000 kv-a.

A motor-operated closing device for oil circuit breakers known as the type MO-1 has been introduced and is believed to be a superior mechanism for indoor or outdoor substation or switch-house use.

With the type MO-1 the speed of closure is high, less than ¼ sec. being required for closure. It is, therefore, suitable for synchronizing purposes and for automatic change-over switching. The motor, which can be operated from a 200-w. potential transformer, resets the spring immediately after each closure, requiring less than 10 sec. The type MO-1 is well adapted for panel, frame or wall mounting or safety enclosed truck type switchboards in substations. It is also applied in switch houses and for outdoor breakers.

For outdoor apparatus of moderate capacity, the type PK-9 marks an important stride toward better distribution service. This breaker is of sturdy construction. An exceptionally strong, rigid frame houses the mechanism and supports the stationary current carrying members with their insulators. The tanks are of rectangular construction, supported by a strong bolt construction and protected by overhanging flanges on the frame. The breaker is furnished for automatic or non-automatic operation in one, two and three poles for 400, 600 and 800 amp. at 7500 v. Estimated interrupting capacity, 3000 amp. at 7500 v.

In the design and construction of switchgear, some important new developments have been introduced, of which the metal clad switchgear of the vertical lift type illustrated is of particular interest.

In this arrangement, complete isolation of each oil circuit breaker unit is provided, with ready means for quick removal of any unit for inspection and repair combined with considerable saving in floor space. The switchgear consists of the main housing of individual circuit breaker cells with bus compartments mounted above and the oil circuit breaker truck units. Each truck unit has a telescopic carriage which, by means of a crank, permits the circuit breaker to be raised until it makes contact with the bus and feeder disconnects. When a circuit breaker unit is removed, shutters automatically close the openings leading to the bus and feeder.

Another important development affording considerable reduction in the cost of electric power distribution while at the same time providing increased reliability of operation and safety is the unit substation, which in one unit combines a power transformer, switching facilities, overload and short-circuit protection and means of metering.

STATEMENT BY DELTA-STAR ELECTRIC CO., CHICAGO, ILL.

One of our recent interesting developments is a new type of outdoor substation in which, by means of rotating bus and switch combinations, the number of insulators used on the older forms of stations have been cut in half.

With the usual form of station, the connections between equipment are purely electrical, serving no mechanical purpose, such as would a disconnecting switch serving both as an electrical conductor and a mechanical device. Large numbers of insulator units are also required for these "idle" connections and every idle insulator and every idle electrical or mechanical joint constitutes an additional expense and hazard. Aside from the initial additional expense in material and labor on the job, thereby lengthening the time required to complete an installation, each idle unit constitutes increased maintenance expense.

The new substation pictured is built more like a switchgear with two sets of buses mounted one above the other. Instead of running connections from these buses over to a set of bus selector switches mounted elsewhere on the steel structure, the bus selector switches are so designed and placed that in themselves they form the tap-off connections from buses to disconnecting switches for the oil switch. The stationary contacts for the disconnecting switches are mounted directly on the buses themselves, the switch blades forming tap-off connections from the main buses. The rotating buses on which the blades are mounted complete the connection to the disconnecting switches.

Aside from the great reduction in insulators, the design also permits a simple steel structure with a minimum of steel details. All bays are alike and each symmetrical about its center line, making all towers alike and girders symmetrical. The structure is easily handled in the field and equipment adjustments are reduced to a minimum.

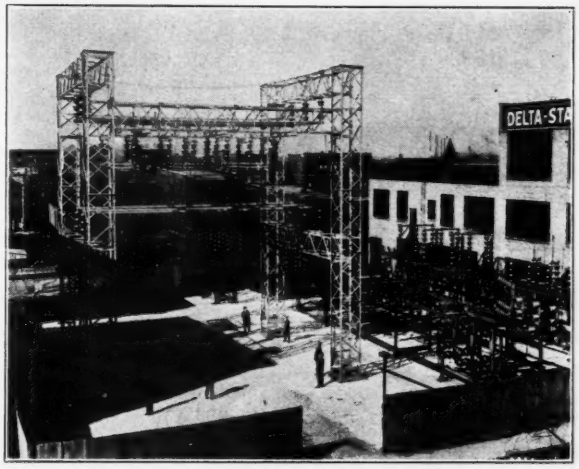


FIG. 2. NEW DELTA-STAR TYPE OF SUBSTATION ON TEST AT FACTORY TEST YARD

This new design is especially adapted for 66 kv. and above.

STATEMENT BY THE PACIFIC ELECTRIC MFG. CORP., SAN FRANCISCO, CALIF.

Among the important developments in the field of switching made by this company during the year are the

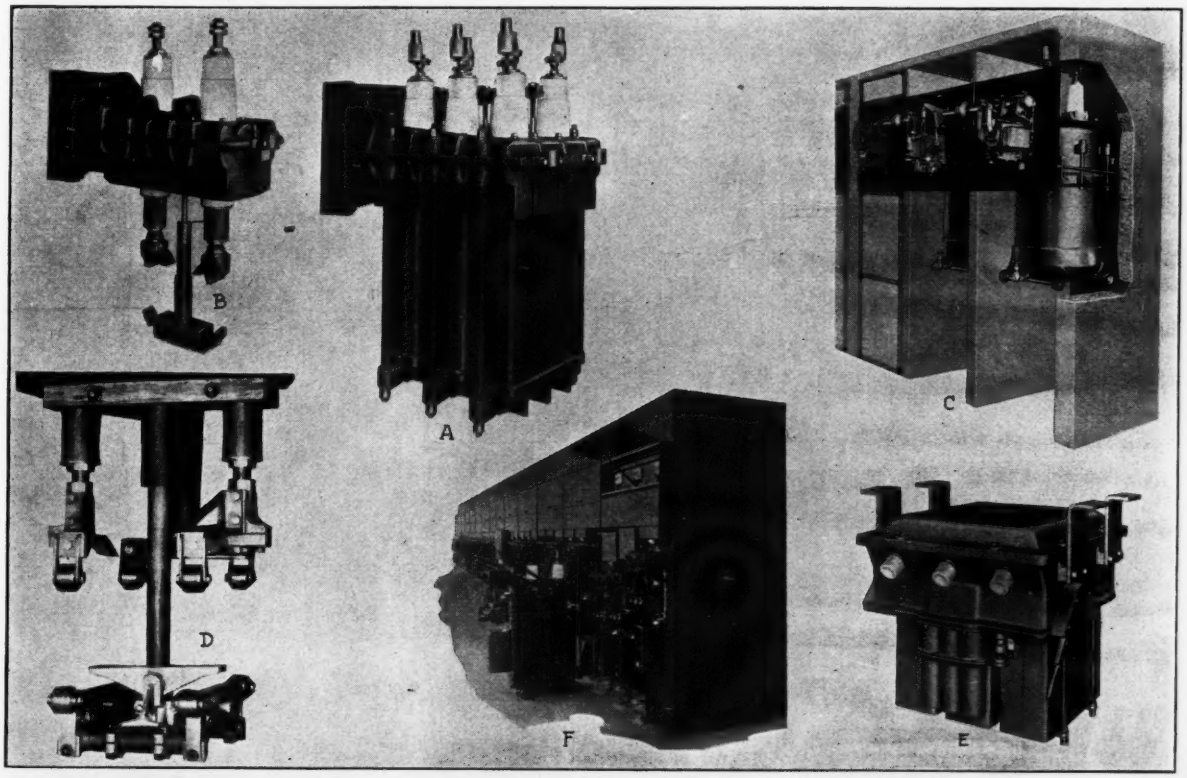


FIG. 1. SWITCHING DEVELOPMENT OF THE CONDIT CO. A. TYPE D-128 OIL CIRCUIT BREAKER. B. TYPE D-117 OIL CIRCUIT BREAKER TANK REMOVED SHOWING CONTACTS. C. TYPE F-120 OIL CIRCUIT BREAKER. D. TYPE F-120 CONTACTS. E. TYPE PK-9 OIL CIRCUIT BREAKER. F. STEEL CLAD SWITCHGEAR, VERTICAL LIFT TYPES

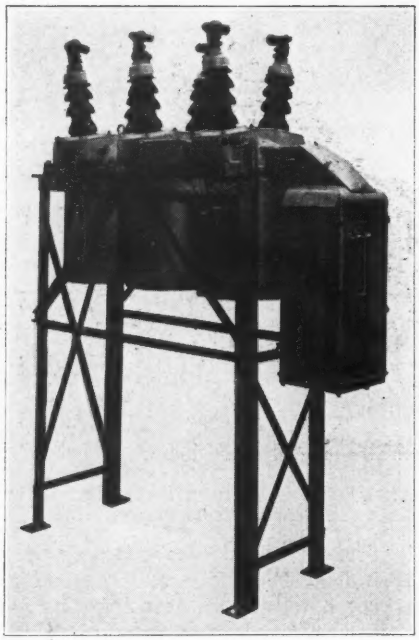


FIG. 3. PACIFIC ELECTRIC MFG. CORP. TYPE JC-17 OIL CIRCUIT BREAKER

new JC-17 oil circuit breaker and the types Y and YS air break switches. The type JC-17 oil circuit breaker, a view of which is shown in the accompanying illustration has the following features:

1. Standard porcelain bushings mounted on flanges. The entire bushing and contact assembly can easily be removed and is interchangeable with other units.

2. The top is a one-piece metal casting to which all operating parts are fastened, thus assuring permanent alinement of the operating mechanism.

3. The breaker is of the individual tank construction, having a gasketed joint between the top and the tanks.

4. The blade action is horizontal and high speed which gives a reserve interrupting capacity over breakers of comparable size.

5. The breaker is supported on a rugged hot dip galvanized steel frame.

6. The breaker is operated by a motor-wound spring-actuated control mechanism that is interchangeable for either end or side mounting without the need of additional parts. The motor operator is equipped with manually-operated buttons, emergency handwinding crank and has a visible position indicator and operation counter.

7. The motor operator can be furnished for either a.c. or d.c. operation.

With regard to our new types Y and YS air-break switches, these are the result of many years of switch manufacturing. They embody features which have proved valuable in the older designs and which have been standardized for uniformity in the present type. The whole assembly of these switches can easily be dismantled for cleaning and repairing. All steel and malleable iron portions of the switches, including all steel springs, are hot dip galvanized. Where voltage conditions warrant, these switches can be fitted with cast metal corona shields.

Statement by I-T-E Circuit Breaker Co., Philadelphia, Pa.

This company has developed an entirely new type of electrical protective equipment—the new "U-RE-Lite" all-steel distribution groups. U-re-lites were primarily designed to be mounted individually near the motor or lighting circuit which they were to protect. The modern trend, however, first in utility plants for auxiliary equipment and later in industrial plants, is toward the grouping of U-re-lites at a convenient point with cables run in conduit to the individual loads. To further this tendency, we have designed the U-re-lite all-steel distribution groups.

By grouping U-re-lites on all-steel frames, distribution units are secured that present many advantages in protection, in convenience and economy. They are of two types, rigid and hinged. In the rigid type, the U-re-lites are mounted on steel panels and the panels bolted to a skeleton framework. Within the framework and integral with it are suitably insulated bus supports. In the hinged type, the U-re-lite terminals are provided with female disconnects which engage with male disconnects. This allows the group to be placed against a wall, as all bus and cable connections are made from the front with the U-re-lites and their panels removed. Except for this disconnect feature, the hinged type is built exactly like the rigid type and is of the same dimension.

Statement by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

The increase in capacity of systems has necessitated active research and development work on interrupting devices. In the field of large high tension oil circuit breakers, notable advances have been made in the design of large capacity high-voltage equipment required for the 220-kv. network now being introduced in the East. The importance of active research and development on interrupting devices is fully recognized by the manufacturers and their facilities for fundamental study are being materially improved. The Westinghouse Co. is providing testing units of 100,000 kv-a. capacity, which, in conjunction with a transformer substation, will permit of testing units from the lower capacities and lower sizes to the highest voltages now in use—that is, 220,000 v. The research work that has been carried on by the company has resulted in the development of new methods of interrupting fault circuits that will soon be placed in commercial service.

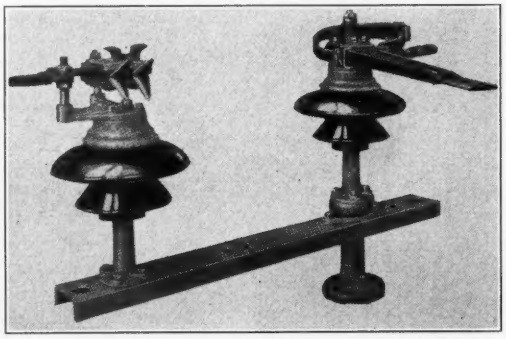
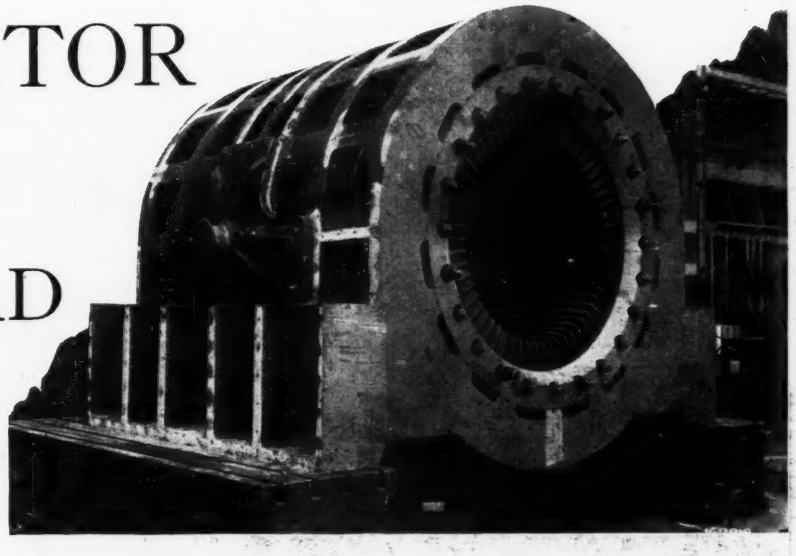


FIG. 4. PACIFIC ELECTRIC TYPE YS, 37-KV., 400-AMP. SWITCH

CONSTRUCTION *of new* GENERATOR *for* CRAWFORD



By J. R. Taylor
Power Engineer,
Westinghouse E. & M. Co.

EARLY IN 1927, the Commonwealth Edison Co. contracted with the Westinghouse Electric and Manufacturing Co. for the installation of a cross compound turbine generator set at Crawford Avenue Station, in Chicago. According to the terms of the contract, the two main generators which are direct connected to a 104,100-kw. cross compound steam turbine are to have a combined capacity of 117,650 kv-a. at 85 per cent, p.f., 12,800 v., 3-phase, and 60 cycles. There is a direct connected auxiliary generator with an output of 5715 kv-a. at 70 per cent, 2300 v., and 60 cycles. The temperature rises of the generators are not to exceed 60 deg. C. by embedded detectors in the armature winding and 90 deg. C. on the rotor by increase in resistance method of measurement. In Fig. 1, a general assembly view of the larger of the two main generators is shown.

Both main generators, as well as the house generator, were shipped as a factory built job ready to set on the customer's foundations. A manufacturer desires to build a unit complete in his own shops because there are certain positive gains to be made by such procedure. The building is done under shop conditions which are a closer approach to ideal manufacturing conditions than can be obtained in most power plants and affords complete control of the processes necessary to successful construction.

*The constructional details of the steam end of this machine were described in the Oct. 15, 1928 issue.

Stator of Skeletonized Frame Construction

On large turbine generators, the piece of maximum dimensions and maximum weight is the complete stator without end bells. All the disadvantages of field built machines to the operator, the carrier, and the manufacturer have been overcome in a skeletonized frame and sheet steel method of stator construction. The skeletonized type frame to be used with a sheet steel super-

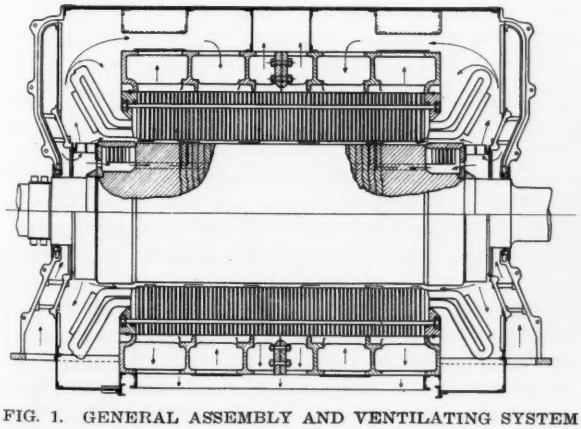


FIG. 1. GENERAL ASSEMBLY AND VENTILATING SYSTEM

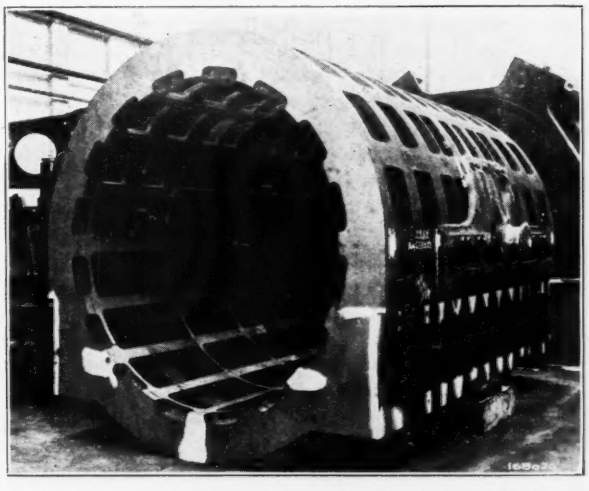


FIG. 2. SKELETONIZED STATOR FRAME CASTING

structure for the larger of the two main generators is shown in Fig. 2.

The stator frame is split into two sections at right angles to the longitudinal axis of the generator. Each section is a complete skeletonized annular casting bolted to the other to form the frame. The complete frame is skeletonized to such extent that its function is reduced to that of supporting and guiding the stator laminations only. Lifting of the complete stator is accomplished by means of removable trunnions which are detached when the sheet steel superstructure is built in place. The feet on which the stator ordinarily rests on the foundations are made removable so that railway clearances are as large as possible on the larger size generators. The stator laminations are punched from low loss sheet steel of the thickness commonly used in large alternators. Insulated through bolts under tension between end plates and non-magnetic finger plates make

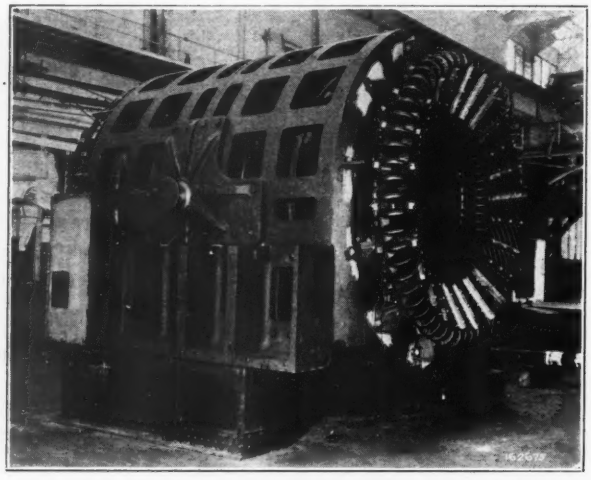


FIG. 3. STATOR WITH WINDINGS IN PLACE

the core self-sustaining and homogenous. The building of the laminations is guided by dovetail slots cut into ribs cast into the stator frame. Impregnation of the stator core with insulating varnish reduces eddy current losses and increases the thermal conductivity of that portion of the magnetic circuit.

Coil Construction

Coils of the stator windings are of the diamond type made in halves. It is expedient to use half coils from a manufacturing viewpoint because complete coils become difficult to handle. The weight of a whole coil for the larger generator is approximately 300 lb. Half coils become satisfactory from a design standpoint by means of strand transpositions within the straight parts of the stator coils. By dividing the strands of a conductor into groups and transposing the strands of a group internally in the slot and then transposing the groups externally, it is possible to make the strands of a conductor occupy all positions in the slot both depthwise and widthwise by the time the phase group is traversed, without adding appreciably to the over-all dimensions of the generator. This plan results in equalized generated voltages and reduced eddy current loss in the armature copper.

Each individual strand of each conductor on the armature coil is insulated throughout with mica tape. The completed coils are encased in a micarta folium wrapper pressed and wrapped by the Haefly process. After the coils have been vacuum impregnated with insulating gum and finish pressed, they are free from trapped air pockets and weak dielectric area. A system of coil supports and blocking is used to prevent destructive movement with the consequently undesirable chafing of insulation under short circuit stress but at the same time, allowing access of cooling air to dissipate the losses developed in end turns. Some idea of the method of supporting the end turns can be obtained from Fig. 3.

Of all types of generators, the ratio of losses developed to volume contained is the largest in turbine generators. This is necessarily true because of space and stress limitations which go with the construction of such machines. In order to dissipate these losses from the small space in which they are generated, it is necessary that the method of dissipation be made most effective. The multiple radial system of ventilation is used on these generators. Air is forced by internal shaft fans to flow across the back of the stator laminations axially and through the vent spaces between packages of stator laminations radially in order to reach the air gap.

In the air gap, the air moves along the rotor body and the stator tooth tips longitudinally in order to reach the radial outlet vent ducts between packages of stator laminations. The air that is heated by the absorbed losses for any particular section of the machine is discharged to the sheet steel air outlet passages formed on the outside of the skeletonized cast frame. With the heated air from the other parallel paths through the turbine generator, this air is passed into the air cooler where the losses are recovered and used in the station heat balance. Air is re-circulated through the generator again and again. The closed circulation system of ventilation is an aid to proper functioning of the generator. By means of it, the ventilating passages inside the generator are kept clean and heat conducting at all times instead of going through a cyclic decrease in heat conductivity between clean-out periods. A further advantage of a closed circulation system of ventilation is that it reduces the fire hazard. First, it allows the generator to be equipped with an inert gas fire extinguishing system which would be difficult and expensive to apply in an open system of ventilation. Second, it reduces the fire hazard of the generator because the amount of oxygen to support combustion is limited to that contained in the system, provided the ventilation system is made reasonably leak-proof.

Rotor Construction

The rotor is of plate construction, and is composed of shaft ends, several plates, and the through bolts. The shaft ends which make up the steps of the rotor between the journals and the full diameter of the rotor body are made of high test nickel steel forgings. Between the shaft ends are placed a series of specially forged carbon steel plates. The shaft ends and plates are held together by four high strength alloy steel bolts located one in each pole center. Each one of these bolts is a forging accurately machined, inserted in the plates,

pulled up to a known tensile stress, and held there by nuts. A known holding force between parts of the rotor is obtained by means of a bolt pulling machine by which the bolts can be brought to a tensile stress by measuring the elongation under tensile load for each bolt. By using this method, the chance for inequalities in pressure between bolts is reduced to a negligible value. The majority of inequalities are caused by the absorption of torque intended to load the bolt in overcoming nut seat friction. With this method, nut seat friction is not a factor because the torque necessary to bring the nut to its operating position can be exerted by the unassisted hand of an ordinary man. After the

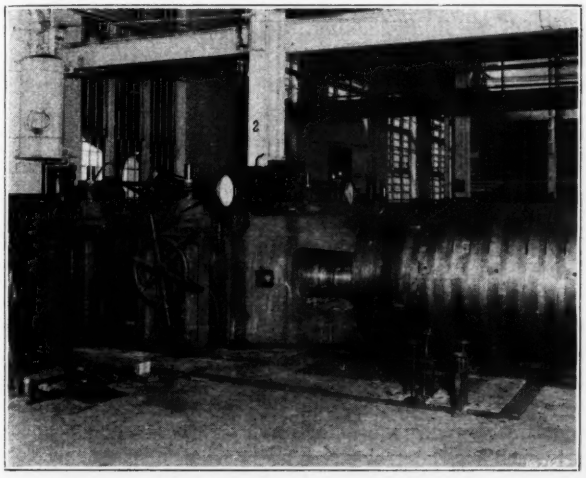


FIG. 4. BOLT PULLLING MACHINE

rotor bolts are pulled to the proper tension, winding slots are cut and bolts again checked for tension. The machine used to place the proper tensile load on each bolt of the rotor is shown in Fig. 4.

The straight part of the winding lies in mica cells in the rotor body. Each successive turn in the slot is insulated by means of a mica strip. Each coil is pressed at a definite high pressure and held at a temperature considerably higher than the value at which the unit is guaranteed to operate. The pressure is applied by means of screws set in special building fixtures. This procedure is followed in order to drive off all the volatile parts of the insulation bond and the varnish solvent. After the building of the rotor coils is complete, the end turns are thoroughly varnished.

In the construction of a highly stressed body of component parts such as a turbine generator rotor, the necessity for retaining the end windings against centrifugal force and at the same time making provision for the repeated relative movement of the parts due to the inequalities of the thermal coefficients of the parts, presents a most difficult problem. In spite of the relative movement of the rotor body, retaining ring, and field coils with the varying temperature caused by load fluctuations, the rotor balance must be maintained. On the end turns, the new type of channel insulation was applied. This insulation consists of molded asbestos channels shaped to interlock and prevent any breakdown to the retaining rings on account of mechanical insulation failure caused by movement of the coil ends relative to the retaining rings. Before this molded asbestos insulation was ever applied to a commercial rotor, it was tested under pressure and temperature conditions more severe than those encountered in service. On the assumption that shut-down occurred once each week, the channel type insulation withstood the number of cycles of heating and cooling corresponding to the change in load from no load to full load for 20 yr. of service without showing any detectable signs of wear.

In Fig. 5, this insulation is shown being applied to the smaller of these two rotors. No radical departures were made from the regular turbine generator practice of securing the rotor winding. In the rotor body, the windings are held in the radial slots by means of nonmagnetic steel wedges while on the ends they are supported by steel retaining rings. The retaining rings are made of chrome nickel alloy steel having an ultimate strength of 100,000 lb. per sq. in. with an elongation of

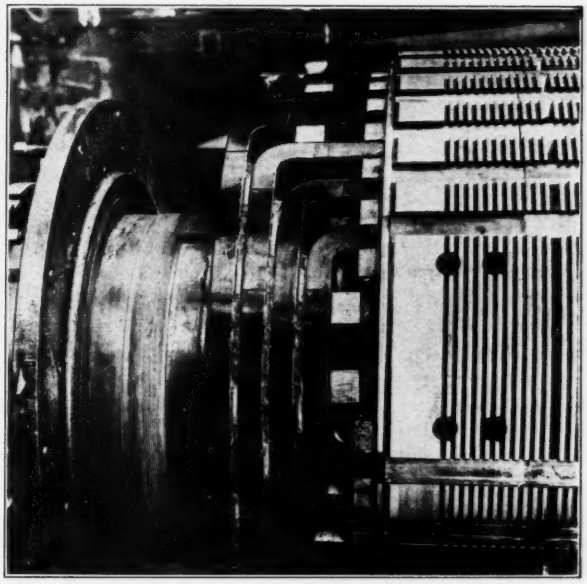


FIG. 5. MOLDED ASBESTOS ROTOR END TURN INSULATION

22 per cent. The rotor end plates are of hot rolled carbon steel. The fans are held to the rotor end plate by means of suitable studs. The blades are of the efficient inclined axially curved blade centrifugal type, developed by Westinghouse for units of large size having shaft fans. Both the rings and blades are made of chrome nickel steel. Air ducts are machined below the bottom of the winding slots in the rotor body beneath the field coils. These axial ducts in turn connect with radial passages formed in the rotor plates by milling away sections on which the bolts do not bear.

GREAT FALLS POWER CO., Great Falls, Montana, a subsidiary of the Montana Power Co., New York, has awarded contract to the Phoenix Utility Co., 2 Rector St., New York, for a hydroelectric plant about 14 mi. east of Great Falls. Work on the project will begin at once. It will include a dam, 900 ft. long and about 90 ft. high, and a power station, to be equipped for about 75,000 hp. capacity. Completion is scheduled late in 1929. Frank M. Kerr is vice president.

Electricity---What It Is and How It Acts*

PART XVI. THE DEVELOPMENT OF A METHOD FOR DETERMINING THE CHARGE ON THE ELECTRON. TOWNSEND'S EXPERIMENTS WITH CLOUD-LADEN AIR. BY A. W. KRAMER

BEFORE MILLIKAN finally conducted his extremely ingenious experimental determination of the exact value of the charge of the electron, a considerable amount of preliminary work on the problem was done by other investigators. Once Thomson had shown that the mass of the electron was only one-seventeen hundredth that of the hydrogen atom, the question of the value of the charge itself took on a new significance and methods were soon devised to answer it. Before we discuss these methods, let us briefly restate the condition of affairs and the problem involved.

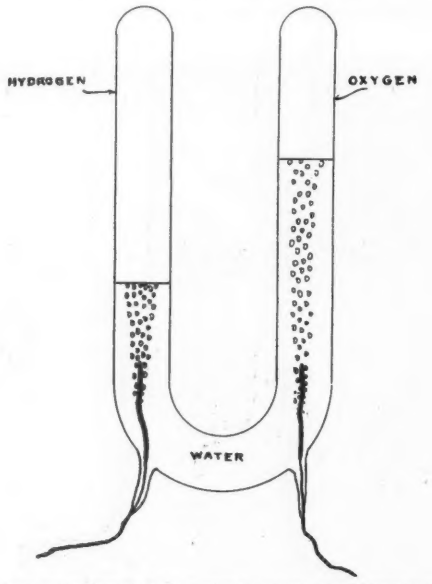


FIG. 1. AN ELECTROLYTIC CELL FOR THE PRODUCTION OF CHARGED OXYGEN GAS

When two electrodes are immersed in a conducting solution of water and connected to a source of direct e.m.f. hydrogen gas will be given off at one terminal while oxygen will be produced at the other. Most of the molecules thus produced are neutral, but once in a million times one escapes with an electrical charge. The gas produced, therefore, carries an electrical charge which can be measured by an electrometer.

WHAT WAS TO BE DONE

Matter which heretofore had always been thought of as consisting of molecules and atoms, the latter being the smallest possible division of matter, was now, due to Crooke's experiments, shown to be made up of still smaller particles called electrons; the atom apparently was made up of these electrons. These electrons, Thomson had shown, were only 1/1700 the size of the smallest atom known, i. e., the hydrogen atom, and carried negative charges of electricity. The question now was, what is the value of this electric charge in terms of ordinary electrical units? The electron, it seemed, was not only the smallest particle of matter possible but its charge was also the smallest electrical charge that could exist in nature. The determination of this charge in terms of ordinary electrical units then, was the problem that confronted the physicists in the late 1890's.

One of the first investigations of this problem was made by Townsend in England. Townsend apparently was a man with no small imagination and with no little presumption. For who but a man with infinite confidence in his ability and with an ingenious turn of mind would presume to weigh a *cloud*, much less count the drops of water in a cloud? Yet that is just what Townsend did, and he did it well, although because of certain incorrect assumptions, his determination of the charge was incorrect.

Now, what on earth have clouds to do with the charge on an electron? This is a logical question and one that would be asked by any man but Townsend; however, we shall see.

ELECTRIC CHARGES ON GASES

It had long been known that gases could carry an electric charge; in fact, certain gases given off at the electrodes in an electrolytic bath were found to be naturally charged. Apparently the gas molecules[1] formed at these electrodes were not all neutral molecules—some of them, at least, seemed to have captured a charge and retained it.

Townsend, in attempting to measure the charge on certain gases found that when such charged gases were bubbled through water, they formed a cloud. This cloud could be completely removed by bubbling it through concentrated sulphuric acid which acted as a drying agent, but it was found that the instant this dried gas was admitted into the atmosphere of a room it again condensed moisture and formed a stable cloud.[2]

From this action, Townsend reasoned that the ions, that is, the charged atoms or molecules of gas, act as centers for the condensation of moisture from the air. Each ion, it seems, attracts a number of atoms or molecules of water to form a tiny drop. These droplets taken together form the clouds with which Townsend experimented.

MOLECULES NOT ALL CHARGED

It was evident, from experiments which had for their purpose the measurement of the electric charge of certain quantities of gas, that only a few of the gas molecules became charged. In other words, in the case of hydrogen gas escaping at the electrodes of an electrolytic bath, most of the molecules formed were neutral. Once in a million times, however, one of the molecules released escaped with a charge—that is, it captured an extra electron or escaped with less than its required number of electrons. These charged molecules, when projected into an atmosphere in which moisture was present or when passed through water, act as centers

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[1]Conduction in liquids, Part VII, p. 880, Aug. 15, 1928 issue.
[2]R. A. Millikan, The Electron, p. 45.

about which the molecules of water collect to form droplets.

Now, it occurred to Townsend that if each ion condensed moisture around it to form a single droplet, then the total number of droplets in a given cloud would represent the actual number of ions present. If this were true and if he had a means of counting the number of droplets, it would only be necessary to divide the total electric charge of a certain quantity of gas by the number of droplets of water formed, to obtain the value of the electric charge on each ion.

Measuring Electric Charges by Electroscopes and Electrometers

It was a simple matter to measure the charge on the gas by means of a calibrated electroscope or electrometer. A gold leaf electroscope is shown in Fig. 1. It consists simply of a pair of gold leaf strips suspended in a glass jar so that an electric charge may be imparted to them by means of the metal rod passing through the top. If a positive or negatively charged body, say a stick of sealing wax, is placed in contact with the ball at the top of the jar, the charge on the sealing wax will pass down the rod to the gold leaves. Being similarly charged, the leaves will repel each other and will diverge as shown in Fig. 2. The amount of divergence is a crude measure of the strength of the charge. An electrometer is built on similar principles but is fitted with a scale whereby the charge may be actually measured.

With an apparatus of this kind, then, it was a simple matter for Townsend to determine the total electrical charge per cubic centimeter carried by the gas.

for the total number of droplets, and by dividing this number into the total electric charge of the cubic centimeter of gas he obtained the average charge carried by each ion, a figure usually designated by e, for convenience.

Details of Townsend's Apparatus

A diagram of the apparatus used by Townsend is shown in Fig. 3. At the left at A is an electrolytic cell producing oxygen gas at the electrode X. This oxygen is first passed through a solution of potassium iodide in B to remove ozone, and then bubbled through water in the flask C where the ions capture water mole-

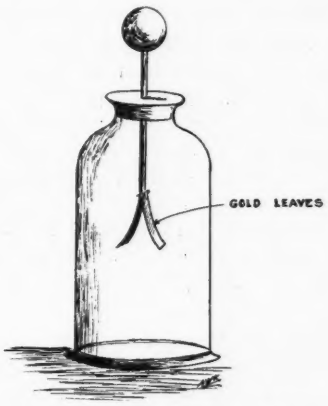


FIG. 2. A SIMPLE GOLD LEAF ELECTROSCOPE

This apparatus consists simply of a glass jar in which is suspended by a metal rod, a pair of gold leaves. When a charged body is touched to the ball at the top the charge is imparted to the gold leaves. When this occurs, the two leaves carrying similar charges will be repelled, causing the leaves to diverge.

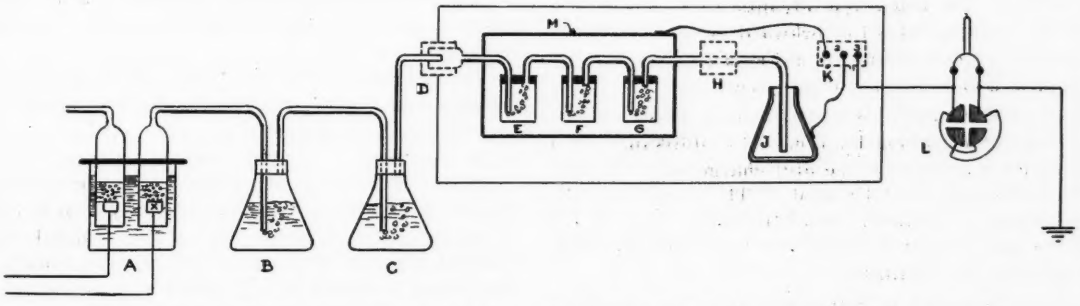


FIG. 3. TOWNSEND'S APPARATUS FOR DETERMINING THE CHARGE ON THE ELECTRON

A. Electrolytic cell producing oxygen. B. Potassium Iodide to remove ozone. C. Water, for production of cloud. D. Paraffin insulator. M. Metal container containing 3 drying tubes E, F, G, filled with sulphuric acid for removing moisture from the gas. H. Paraffin insulator. J. Flask coated on outside with tinfoil to collect electric charge. K. Electrical connection block. L. Quadrant electrometer used for measuring the charge on flask J and metal box M

His next step was to weigh the cloud formed around the ions. This he did by passing the cloud through a series of tubes containing chemicals which absorbed all the moisture without in any way affecting the gas itself. It was evident, therefore, that if he weighed the drying tubes both before and after the cloud had been absorbed, the increase in weight of the tubes would be a measure of the weight of the cloud.

Next he determined the average weight of the water droplets constituting the cloud by observing their rate of fall under the action of gravity and computing their radius with the aid of a purely theoretical law known as Stoke's Law. By then dividing the weight of the cloud by the weight of the drops, he obtained a figure

cule to form a cloud. This cloud-laden air then passes into a chamber M which is electrically insulated from the earth by paraffin blocks D and H, and which contains tubes E, F, G, containing concentrated sulphuric acid. These are the drying tubes whose function it is to remove the moisture from the cloud. They also remove such part of the charge as is held on ions which in the process of bubbling through E, F, G, have actually touched the sulphuric acid. The dry air containing the rest of the charge next passes into the flask J, the outside of which is covered with tin foil and connected to the electrical connection block K. By means of the latter, the quadrant electrometer L can be connected first to the outside of the flask D and then

to the outside of the metal chamber M. The quantity of electricity on the air entering J and also that appearing on M can be measured by noting the deflections in the electrometer per min., as the gas is passing through the system.

In this apparatus, Townsend had a means of determining the total charge on the gas, as well as the weight of the cloud formed by passing the charged gas through the water. The quantity of gas entering the system could easily be determined by measuring the current used in producing the oxygen and the electrochemical equivalent of the gas. His method of arriving at the number of droplets in the cloud and the average charge carried by each ion has already been explained.

However ingenious this experiment of Townsend's, it was marked by a number of weak points, all of which combined to introduce errors into the result. In the first place, his assumption that the number of ions is the same as the number of droplets was unfounded. Second, Stoke's law, which he used in weighing the drops, had never been tested experimentally and from a theoretical standpoint this law might be expected to be in error when the droplets were small enough. A third weak point was the assumption that all the droplets in a cloud were of the same size.

Notwithstanding these faults, the experiments of Townsend were of considerable value, for they pointed the way to other methods in which these sources of error were eliminated. Townsend conducted his experiments in 1896. His attempts to determine the value of the charge on the electron were followed by those of Thomson and H. A. Wilson.

Both Thomson and Wilson worked with clouds. Thomson's method had few advantages over Townsend's but Wilson eliminated the awkward assumption that the number of droplets formed is the same as the number of ions and this was a real advance.

None of these methods approached in accuracy and perfection the method later used by Millikan. Wilson obtained for a value of the unit charge on the electron, 3.1×10^{-10} electrostatic units. This was closer than that obtained by previous investigators but was still far from the exact value 4.774×10^{-10} electrostatic units later obtained by Millikan.

The whole history of the evaluation of the charge of the electron is a beautiful example of the development of a method. Here was an entity—a tiny something which we could never hope to see, so small, in fact, a million million of them would find oceans of room on the point of the sharpest needle,—which carried an electric charge; yet gradually a method was evolved whereby this charge was measured with remarkable precision. Millikan's famous oil drop experiment will be described in the next article of this series.

ACCORDING TO the latest report of the Geological Survey, Department of the Interior, production of electric power by public utility power plants in the United States for November, 1928, reached a total of 7,752,648,000 kw-hr. This is an increase of 13 per cent over the output for November, 1927. Of this total, 4,971,919,000 kw-hr. were generated by fuels and the remainder by water power.

Danger of Low-Voltage Circuits

BY MARIN PHILLIPS

ELECTRICITY can not be compared with the worst kind of a viper, as it will strike without giving any kind of a warning. A switch or wire carrying 10,000 v. looks ever so innocent and harmless. It is. If you do not touch it, it will not harm you. If you don't touch it, is a broad warning to give to electricians and maintenance men in the electrical field. With industrial plants running six and seven days a week, it becomes necessary to work on live circuits and there is always risk to be run when working on live circuits. How much risk is present depends on how much precaution is exercised by the man doing the work. If the work is rushed into without taking the danger into consideration or disregarding the safety rules, the risk will be high but if proper precaution is taken and the safety rules followed, the risk to be taken can be lowered to an extremely low degree. All low voltage circuits should be treated with due respect. Treat them as if they were high voltage circuits. Contact with low-voltage circuits often proves fatal. In one instance, a workman came in contact with a lighting wire while working in a very wet place and was killed. The voltage was measured and found to be 98 v. direct current. Another fatal accident happened to a workman while inside of a boiler cleaning it out, by coming in contact with the extension cord which was used to supply light. The voltage was around 110 a. c. yet a. c. voltages of 440, 550 and 600 v. are ordinarily considered low and harmless.

Low voltage will not kill outright as will high voltage but will wear the victim out in case he becomes stuck to it.

All voltages above 440 v. should be classified as high voltages and treated as such by all who chance to be around.

SOMETIMES an occasion arises where it is desirable to parallel a line of feeder cables or buses with another in order that the load can be more evenly divided and distributed between the feeder lines. It is a general practice among workmen to rely wholly on a test lamp when phasing out the circuit in order to locate the corresponding cables so that they can be tapped together. Unless precautions are taken, this is a good place to develop a short circuit that will do a lot of damage. When making these parallel connections, it is always advisable to make some form of a check on the lamp test. An easy and sure check test to make is to first test with a piece of small fuse wire. The lamp may have burned out or in some way failed to light, thereby causing an attempt to be made to parallel wires of opposite polarity or phase resulting in a short circuit.

CAPITAL STOCK of the Iowa Electric Co., operating in Eastern Iowa, has been increased from $2,000,000 to $3,000,000, amendment to the charter filed in Cedar Rapids, Iowa, recently revealed. C. S. Woodward, secretary, said that the increase was necessary because of the company's increased holdings. Twenty thousand additional shares of preferred stock have been issued.

Welding in Power Plants

AT THE CONVENTION of the International Acetylene Assn., recently held in Chicago, several reports and papers bearing on welding practice, as it is utilized in power plants were presented.

Bronze welding of steel parts was explained and discussed by I. T. Hook of the American Brass Co., the advantage being large savings in time and money. The technique is slightly different from that with iron welding rods, but is easily learned. Comparative costs on four jobs were given as follows:

	Iron		Bronze	
	Hr.	Cost	Hr.	Cost
Welding and machining stud flange in front end locomotive cylinders	37.	$103.32	16.	$54.91
Welding back cylinder head	2.5	6.26	0.5	1.73
Welding break in pump	12.	29.76	5.	14.76
Filling in base casting, crane turret	6.	32.56	2.	7.17

Hard facing of soft metals with wear-resisting surfaces such as Stellite was described by F. P. Gormely of the Haynes Stellite Co. The work covers coating of boilers, grates, worn shafts, fan and pulverizing mill parts,—the surface metal being firmly welded to the cheaper base material. By special use of carbonic acid, heated by an oxy-acetylene torch, it is also possible to coat containers and pumps with lead for handling chemicals. Hard surfacing of trolley shoes, clutch parts, valve-mechanism bearing parts and the like has increased the life and smooth action materially.

In construction work, such as piping, headers, belt and gear guards, hoppers and furnace bottoms, the use of welding is increasing, one main 4000 ft. long, of 20-in. pipe to carry 200 lb. being installed without flanges or bolts, except at expansion joints.

In one plant, pulverized coal and oil furnaces are ignited, on starting, with an oxy-acetylene torch.

In piping construction, a major consideration, as brought out by J. H. Zink of the Heat & Power Corp. is that joints stay tight, so that going over a job to remedy leaks is eliminated. This is important to the piping contractor and is in addition to the lower cost that can be secured by taking advantage of the possibilities for economy in designing a piping system for welded construction. It applies to heating and plumbing systems as well as to high-pressure work.

Pressure vessels have been a cause of argument between engineers and advocates of welding but the working out and adoption of a system of procedure control seems to have solved the problem. The requirements of procedure control are:

A. Check of welders to insure that only competent operators of proved ability are employed on the work.

B. Selection and inspection of material to secure the use of material suitable to welding and of proper welding rod.

C. Correct design and layout of joints to be welded.

D. Use of the best method of preparation and assembly of parts for welding.

E. Inspection to insure that welding is correctly done in the most satisfactory and economical manner.

F. Check of the preceding items to make sure that the procedure has been followed and test of completed work.

Standard specifications, based on this method have been prepared for many operations and pieces of equipment and sent out to jobs done far from the engineering office, the results being perfect work even on piping of large diameter and on pressure vessels up to 90 in. diam., 90 ft. long with shells 1 in. thick for 200 lb. per sq. in. working pressure. Design was for fiber stress of 9000 lb. per sq. in. Pressure as high as 400 lb. per sq. in. have been handled but in non-fired vessels. Pipe lines from 8-in. to 20-in. diam. are being built by welding, of lengths up to 1300 mi.

Development of procedure control has advanced so that a code for unfired pressure vessels is now in preparation by engineering committees for the Boiler Code Committee of the A. S. M. E., who, it is understood, will probably place oxy-acetylene welding on the same basis as hammer welded construction for such work. Welding for boilers, where the safety of the structure depends upon the strength of the weld is not authorized and boiler welding should be undertaken only with the sanction of the State Boiler Inspection Department or the inspector of the insurance company covering the boiler.

In view of the advances in the art of welding, it would seem that, for any job of construction, overhauling or repair, the power plant executive should give careful consideration to the utilization of this process to secure permanence and durability of construction as well as economy in time, labor and cost of material and parts.

Fiber Stress in Welded Structures

IN A PAPER before the American Welding Society, S. W. Miller discussed allowable fiber stresses in welded structures and suggested the use of the formula by A. B. Kinzel: $S = (T \sqrt[3]{E \div 10}) \div 7.15$, where S is allowable working fiber stress, T is ultimate tensile strength and E is percentage elongation, of a test weld, measured by a bending test. Comparing a table worked out from this formula with stresses allowed by the Boiler Code, he finds that there is substantial agreement. He states that the stresses are higher than have before been presented for consideration for welds but no higher than have actually been used with safe results. They are based on proper procedure control in making the welds and work done by skilled operators. The stresses run in the table from 5000 lb. for tensile strength of 45,000 lb. and elongation of 5 per cent up to 14,200 lb. for ultimate strength of 75,000 lb. and elongation of 25 per cent. For nickel steel, with values of 70,000 lb. and 23 per cent, the formula gives 12,900 lb. stress, while a factor of safety of 5 gives 14,000 lb. working stress in the metal. For cast iron, with values of 20,000 lb. and 2 per cent, the stress from formula is 750 lb. and factor of safety of 20 gives 1000 lb. In both cases, the formula gives values within good practice. The assumption is, of course, that the weld will be as strong as the joined metal, which Mr. Miller states has been shown in tests to be the case when welds are properly made.

Editorial Comment

Diesel Power Field Broadened by Court Decisions

Investigation of the power situation, particularly in the Middle West, presented two seemingly opposing developments; one, the combining of many small as well as large plants into a single organization and involving the purchase of many inefficient plants in order to provide power from efficient plants to be transmitted by high-tension lines to the various towns composing a group; the other, the rapid growth of municipal Diesel power plants. Although Diesel application to municipal plants ranks fifth in a list of 21 major applications, it lags little behind the applications of Diesel power which are foremost in the United States.

While it is well known that power can usually be more cheaply produced in a large steam central station, when the station is modern in its equipment and organization, than in a smaller Diesel plant, the price actually charged municipalities for power and light is often far in excess of the cost of such power and light when generated in a municipal Diesel plant.

Whether or not a municipal plant will pay depends much upon the degree of civic consciousness that exists in a municipality. If civic ideals are guarded with great zeal, as is done in many of our midwestern towns and small cities, power can be furnished at low rates. Especially is this true where the municipality is organized under the commission form of government and managed by a city manager who is an engineer.

In large cities where civic consciousness is usually dormant and where selfish political action is frequently permitted to exercise unhampered control, the municipal plant furnishes merely one more opportunity for distribution of patronage by the controlling political party and results in the establishment of soft jobs for a few favored, although often not qualified, persons.

One of the incentives that has helped materially to advance the building of municipal plants is the sale of equipment based principally upon payment for such equipment out of the earnings of the plant. The proposal usually specifies that the manufacturer will furnish the power machinery and equipment, if the city will bond and build the distribution system, the plant to be paid for out of the earnings. Much opposition to this plant has been aroused by operators of central stations, based upon objections usually raised through some citizen of the town to bonding the town for amounts beyond those specified as legal.

Decisions in many courts have, however, sustained the legality of paying for municipal plants out of earnings. In a recent decision in favor of the city of Cavalier, North Dakota, rendered by Judge G. Grimson, he submitted that, while all expenditures for governmental purposes must be provided for under the budget law, other expenditures have grown up in connection with the administration of city government that are for functions proprietary rather than governmental and as to them the city becomes a quasi private corporation, which, in the nature of things, must carry out such duties much like a corporation.

The budget law, he states, applies to all expenditures depending upon taxes or other governmental income such as licenses. The proprietary function of the municipality depends, usually, not on the taxes but on the income from such enterprise and it would be impossible to anticipate a year in advance the expenditures necessary to carry on such an enterprise.

Lighting rates and income from such proprietary enterprise, he continues, are not in any sense taxes. They are incomes, which are the result of an agreement between the customers and the city. A tax is not the result of any agreement but is a positive act of the government. Such rates are, therefore, in no sense a tax. The court came to the conclusion that the power transaction did not involve an indebtedness on the part of the city such as was contemplated by the debt limit, as it is clear that no general liability upon the city is intended, since the manufacturer has nothing to fall back upon except its own property. The city is in no danger of losing anything by a contract of this nature, since its only obligation is to operate the plant and pay over to the contractor the net proceeds of that enterprise to apply upon the purchase price of the generating plant.

Decisions such as that given above should open a way for municipalities, that would otherwise be unable to raise sufficient funds to pay for a plant, to enjoy low lighting costs, otherwise unavailable to them. This broadens the growing field of Diesel power.

Dust Collectors in the Power Plant

With the introduction of pulverized fuel, ash carried out of the stack and deposited on the surrounding countryside began to cause difficulty for both the public relations men and engineers.

Collection of this dust from the flue gas between the boilers and stack has been experimented with over a period of several years and, although a dozen or more devices have been developed and applied, it appears that the problem has not as yet been solved successfully.

Electrical precipitation, successfully used for years in the copper industry, has been tried with some success, although it is said to be expensive in first cost and operation. Cyclones, sprays, fans and mechanical methods utilizing centrifugal force and momentum have also been tried with more or less success on material of 100 or 200 mesh and larger.

Whether or not the successful removal of this coarser material will quiet the objections to pulverized coal plants in or near residential districts is questionable. Power plant men think that it will, while men who have been following similar developments and difficul-

ties in the cement industry feel that it will not; dust of minus 200 mesh is a factor which cannot be neglected.

Naturally, the finer the dust the farther it will be carried before being deposited on the ground or on buildings. In the cement industry, complaint from dust sometimes comes from as far as ten miles. Cement dust is easily identified. Pulverized coal dust, on the other hand, is not so easily identified and, in the northern states especially, fine flue dust could not be distinguished from the always-present soot and ash from household furnaces.

Possibly future developments will show whether or not minus 200 mesh flue dust is important from the power plant man's standpoint. If it is not, present equipment may answer the question; if it is, new developments will be in order.

Off Duty

Almost everybody, no doubt, is familiar with the story of the boastful Irishman showing his friend the wonders of New York City, emphasizing particularly the speed with which skyscrapers are erected.

"And phwat moight that buildin' be?" asked his bewildered companion, pointing to a conspicuous 35-story structure.

"That?" exclaimed Pat in amazement, "well, begorra, oi niver seen it before. 'Twasn't thair yisterday."

Pat's plethora for speed, although a trifle exaggerated is, nevertheless, characteristic of this age. The world seems obsessed with a mania for speed. Read the 6-in. headlines of our metropolitan dailies. "First with the latest," screams the modest 'Hohokus Gazette,' gloating over its unfortunate competitor, the 'Daily Defamer,' whom it has beat on a first class murder story by a matter of 57 minutes. Picture the utter dejection of the editors and the reporters of the 'Defamer' when they read these heartbreaking headlines.

In another neck of the woods we have J. Lucius Cracker, financial genius, captain of industry, chairman of 17 boards of directors. J. Lucius is in a dilemma because of his inability to be everywhere at once. Here are two directors' meetings, one of the Consolidated Ash Can Corporation in Cleveland and the other of Doorknob, Inc., in New York, scheduled for the same day and J. Lucius Cracker's presence is required at both. What to do! What to do!

"D—n it, Miss Peach," ponders J. Lucius, profanely, to his pretty secretary. "They expect an executive to be ubiquitous these days." "Ubiquitous" is a good word and the important "Cracker" glances to see whether Miss Peach is sufficiently impressed. She is—Miss Peach knows her onions, so to speak. "How can they expect me to preside at Consolidated Ash Can at 9 a. m. tomorrow and yet be in the New York office of Doorknob, Inc., at 5 in the afternoon. It can't be done, confound it! It can't be done!"

"Why not call the Amalgamated Air Transport and engage a plane?" suggests the proficient Miss Peach. "A plane would get you to New York in five hours."

"That's it," snaps the peppy J. Lucius Cracker, suddenly staggered by the idea. "That's just the thing. I tell you there's nothing like being master of a situation. Call the Air Transport at once, Miss Peach, and tell them to have a plane ready for me at 10:22 sharp tomorrow; and, by the way, also notify the 'Hohokus Gazette'—have 'em send a photographer around."

And so we read with amazement of the inestimable value of airplane travel to the modern executive; how, upon eating breakfast in Chicago or Cleveland and participating in an important conference, he hops into a plane and lands in New York at 5 in the evening in time for an important meeting, having dictated letters at high speed, to his secretary all day. "The airplane is an absolute necessity in modern business," is Mr. Cracker's dictum as reported in the columns of the 'Hohokus Gazette.'

Speed! Speed and more of it. Here is Horace Augustus Blop, calling Mr. Plop on the telephone. He has to wait 30 seconds before the operator replies.

"Well, blankety blank, blank, what's wrong with this telephone service," shouts the impatient Blop. "Do you think I can wait all day for this connection? Gimme the manager, blankety blank! *?"

Again we have Yvette Bluette, the beautiful movie actress who has been resting in Southern France for several months, rushing home to Hollywood. She has just missed the Aquitania but her press agent saves the day by chartering a plane and she boards the liner before it has cleared the Scilly Islands. The news is flashed to the four corners of the earth and the New York Tabloids carry a diagram of it. Cross marks spot where actress landed.

All of this recalls the story of a New Yorker, taking a Chinese friend home to dinner. "Let's hurry and catch this subway train," he urged his oriental companion, "we'll save five minutes if we get it."

"Very well," said the Chinaman blandly, "but what will we do with the 5 minutes after we save them?"

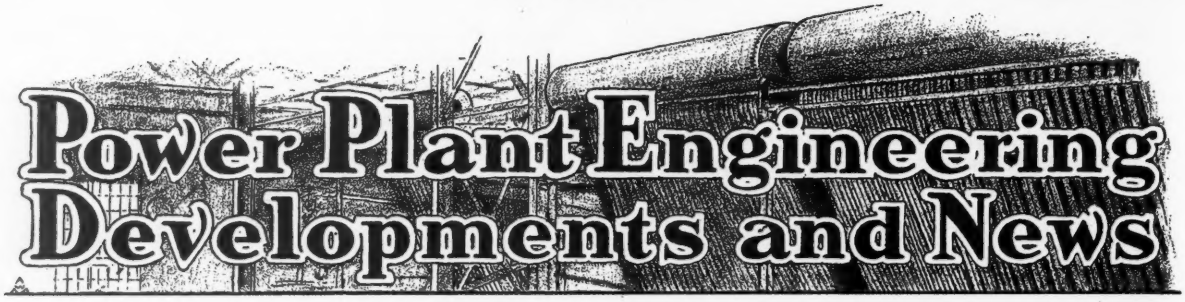
Faster and faster. Everything must be done in a hurry. "How long does it take you to shave?" demands the new safety razor ad. One minute? Throw your razor in the ash can and buy a "Trick high speed repeating automatic— A new blade for every stroke. Save 15 seconds!"

The average person of affluence today must always be on the go. He or she is forever either leaving for London, or Paris or where not, or is sailing for home. Only the highest speed conveyances will do. Even the five-day transatlantic greyhounds and the 20th Century Limited are too slow for these people and they are looking forward with anticipation to transatlantic Zeppelins and high-speed airplane transport.

Some day, perhaps, when the secrets of the atom have been revealed—when we shall have mastered the problem of traveling through interstellar space on the wings of radiant energy, we shall be able to move much faster. According to the Einstein theory, the velocity of light is the limiting velocity in nature—in other words, nothing can move faster than light. We shudder to think of the day when we shall have attained this speed and when there will be nothing faster to look forward to.

Yearly Index

INDEX for Volume XXXII of Power Plant Engineering is now prepared and will be sent free to subscribers upon request.



Electrical Engineers to Meet at New York, Jan. 28 to Feb. 1

MEMBERS AND GUESTS of the American Institute of Electrical Engineers will have an opportunity to participate in a well rounded program of important technical sessions and enjoyable recreation at the winter convention to be held in New York in the Engineering Societies Building, January 28 to February 1. Technical sessions, a lecture, medal presentations, a dinner dance and a smoker constitute the features of the program.

Some of the livest topics in electrical engineering will be discussed at the technical sessions. Many papers are to be presented on dielectrics, electrophysics, cables, transmission, lightning, circuit breakers, communication, motors, and related subjects. One especially interesting session will deal with a new type of circuit breaker which employs no oil and in which heavy currents are interrupted with great rapidity.

A large number of inspection trips have been arranged among which are trips to the Well Gate Generating Station, Bell Telephone Laboratories, the Western Electric Co. plant at Kearney, the Electrical Testing Laboratories, the Newark Meter Works of the Westinghouse Electric and Manufacturing Co.

Two medals for achievements in electrical engineering will be presented on Wednesday evening, January 30. These are the Edison Medal and the Lamme Medal.

Engineer-Teachers' Summer School at Purdue

IMPROVEMENT in the methods of instruction used in engineering colleges is the object of the summer school for engineering teachers to be held at Purdue University, Lafayette, Ind., June 27 to July 18, 1929. At this, the fifth annual school, about half the time will be devoted to general meetings for study of principles of teaching, organization and administration of colleges and purposes of engineering instruction. The balance of the instruction will be in three groups on heat power engineering, mechanism and machine design, production engineering, with leaders interested particularly in these divisions.

Work of this summer school is sponsored by the Society for Promotion of Engineering Education, Purdue University and Western Electric Co. Some 75 teachers of engineering will attend and instruction will be by 30 or more leaders from college teaching staffs and the industries. Dean A. A. Potter of the Purdue School of Engineering will serve as local director and H. P. Hammond, associate director of investigation of the S. P. E. E., will have general charge. Further information may be had from Professor Hammond at 39 W. 39th St., New York City, to whom applications should be sent.

A. S. H. & V. E. Meets Jan. 28 in Chicago

AMERICAN SOCIETY of Heating and Ventilating Engineers will hold its 35th Annual Meeting at the Edgewater Beach Hotel, Chicago, Ill. from Monday, January 28, to Thursday, January 31, next.

The first day's activities will include a general session, meeting of the nominating committee and an informal reception and dance in the evening.

On Tuesday, the morning session will hear papers on radiator performance while, at the afternoon session, the committee on research will report and papers dealing with various phases of heat transfer problems will be presented. The past president's dinner will occur on Tuesday evening. The morning session on Wednesday will hear papers on air conditioning and the annual banquet and dance will be held on Wednesday evening.

Thursday morning there will be a discussion on correlating thermal research and a report of the heating and ventilating subcommittee and in the afternoon there will be a paper on fan performance in terms of direct pressure quantity relation. This will be followed by installation of officers and the council meeting.

Further detail information can be obtained from H. G. Thomas, general chairman, 549 West Washington St., Chicago, Ill., or from A. S. H. & V. E. headquarters, 29 West 39th St., New York City.

News Notes

D. M. ARCHER, engineer, formerly with Webster Tallmadge & Co., Inc., has now joined the engineering department of the Sarco Co., Inc., New York.

PENNSYLVANIA FORGE CO. announces the removal on December 28 of its main office to its new plant at Milnor and Bleigh Sts., Tacony, Philadelphia, Pa.

INTERNATIONAL COMBUSTION ENGINEERING CORP., New York, announces that its subsidiary, the F. J. Lewis Manufacturing Co., producers of coal tar products, will henceforth be known as the International Combustion Tar & Chemical Corporation, with offices at 200 Madison Ave., New York, and 2500 South Robey St., Chicago.

THROUGH A reorganization affecting its Pacific Coast territory, the Timken Roller Bearing Co., Canton, Ohio, has established two new permanent offices. One of these

is in Los Angeles, Calif., at 1361 South Figueroa St., in charge of Roy Cross; the other is at 321 East Pine Street, Seattle, Washington, in charge of Marshall Cooledge. G. C. McMullen remains as district manager at the company's San Francisco office.

EDWARD VALVE & MFG. CO., East Chicago, Ind., announces that J. E. McDonald, its sales manager, has resigned to become vice president of the B. Floersheim Co., Inc. of Pittsburgh, Pa., effective January 1, 1929.

GRISCOM-RUSSELL CO., New York City, announces that its Boston business office is now located in the Chamber of Commerce Building, 80 Federal St., Boston, Mass.

LINK-BELT CO., Chicago, Ill., announces the addition to its line of a heavy duty ¾-cu. yd. Crawler-Shovel-Crane-Dragline known as type K-25. The new unit is designed to be rugged and fast and is powered with gasoline engine, Diesel engine or electric motor drive as desired. As a shovel it is equipped with ¾-yd. struck-measure-capacity dipper. As a dragline or crane it is designed to handle a ¾-cu. yd. bucket on a 40-ft. boom. It has one-piece annealed cast steel lower frame and rotating base, self-cleaning chrome steel crawler treads and large bronze bushed crawler rollers. Totally enclosed lower-frame travel gears operate in oil and a steel house encloses the operator and the machinery. The unit is designed to be quickly and easily convertible from shovel to crane or dragline, or vice versa, without changing or disturbing the mechanism.

CINCINNATI CAR CO., Winton Place, Cincinnati, Ohio, announces that it is now marketing a complete line of industrial locomotives in gasoline, gasoline-electric, Diesel, electric trolley and storage battery types. These will be furnished in a variety of sizes from 2 to 3-t. units up to 50 t. or larger and in various track gages, affording equipment suitable for handling equipment either small or large in all kinds of industrial service, as well as in switching railroad cars.

ON WEDNESDAY, December 19, 1928, the New York office of the Brown Instrument Co. was removed to Room 1502 Roebling Building, 117 Liberty St., New York City, removing from 50 Church St.

HOLLOW CENTER PACKING CO., Cleveland, Ohio, has opened a branch office at 321 Broadway, New York City. Ernest H. Smith, president of the company, will spend several months at the new office and will manage it until the branch manager has been appointed.

WILLIAM W. TEFFT, who has been chief engineer of the Commonwealth Power Corp. for the last five years, has resigned to devote his entire time to his consulting engineering practice. He continues his residence and official headquarters in Jackson, Mich., where he has resided for many years. His association with the Commonwealth properties began in 1902 and continued throughout his association with the late W. A. Foote and until the properties in Illinois, Ohio, Indiana and Tennessee have become a part of the corporation. For some years preceding his appointment as chief engineer of Commonwealth Power Corp., he was a member of the firm of Fargo Engineering Co., whose activities extended throughout the country especially in connection with designs of earth dams on soil foundations. Mr. Tefft is the inventor and owner of the Tefft conduit spillway and accelerator, which has been installed in several large hydroelectric developments during the last few years. Always active in the educational life of Michigan, he is president of the board of trustees of Albion College, which position he has held for the last seven years.

ANNOUNCEMENT is made that the Spray Engineering Co., formerly of Boston, Mass., and the Spraco Painting Equipment Co. were merged on January 1, 1929, and will continue to do business hereafter under the name of Spraco, Inc. The company is incorporated under the laws of Massachusetts with new offices and factory facilities combined at 114 Central St., Somerville, Mass. All the assets and liabilities of the two companies will be transferred to Spraco, Inc., as of January 1, 1929, and after that date all checks, invoices, contracts, and so on, will be made in the name of Spraco, Inc. Thomas W. Pelham is Chairman of the Board of the new company and Wayne B. Thompson is president.

F. A. BURROWS MANUFACTURING CO., York, Pa., has recently placed on the market the Burrows continuous-discharge steam trap for pressures from 0 to 100 lb. per sq. in. This is a float type trap, the valve being actuated through levers by the rising and falling motion of the float. The traps are intended primarily for application to heating coils, radiators and similar equipment and are made in two sizes, number ½ for 200 sq. ft. of radiation and number ¾ for 600 sq. ft. of radiation.

THOMAS CRAWFORD, general manager of the electric and gas utilities of the Interstate Power Co. in Clinton, Iowa, for more than 23 yr., has resigned his position, effective January 1. G. B. Miller, Oelwein, will succeed him and is already in Clinton studying the new plant. Mr. Crawford was associated with the Clinton Gas & Electric Co. prior to its sale to Interstate Power in April, 1926.

D. L. KOONTZ, mechanical engineer, announces the opening of an engineering office at 176 West Adams St., Midland Building, Chicago, Illinois. Mr. Koontz will specialize in steam plant design, auxiliary power equipment, industrial design, special investigations and engineering reports.

ACCORDING TO D. K. Swartwout, Jr., vice president and general manager of The Swartwout Co., all the operations of that organization will henceforth be conducted in Cleveland, Ohio. To provide for the new activities The Swartwout Co. has purchased a building containing 90,000 sq. ft. of floor area and approximately seven acres of ground, located at 18511 Euclid Avenue. Operations of the S-C Regulator Co. have already been transferred to this plant, but activities of the Orrville factory will not be moved to Cleveland until the present tenants in the newly purchased building have left it, which will be during the next six months.

AMERICAN INSTITUTE of Electrical Engineers, through its Edison Medal Committee, has awarded the Edison medal to Dr. Frank B. Jewett for his contributions to the art of electrical communication. Dr. Jewett, who is now vice president of the American Telephone and Telegraph Co. and president of the Bell Telephone Laboratories, Inc., is a graduate of Throop Polytechnic Institute, now the California Institute of Technology, and studied with Professor A. A. Michelson at the University of Chicago, receiving his degree of Doctor of Philosophy in 1902.

In 1904, Dr. Jewett joined the staff of the American Telephone and Telegraph Co. and began his engineering research work in the telephone field. Under the direction of John J. Carty, then chief engineer, Dr. Jewett worked out methods which led to phantom loading of large gage and open-wire circuits, practical use of telephone amplifiers and development of phantom duplex cables. In 1912 he became assistant chief engineer of the Western Electric Company and in 1916, chief engineer. During the war, he served in the Signal Corps and in 1925 was elected to his present position. He is a Fellow of the American Institute of Electrical Engineers and member of other scientific and engineering organizations.

H. L. R. EMMET has been appointed manager of the Erie, Pa., works of the General Electric Co. and J. E. Brobst has been named manager of the Bloomfield, N. J. plant, succeeding Matthew Griswold at Erie and C. D. Knight at Bloomfield, both of whom retired from active service on January 1 because of ill health.

NATIONAL FLUE CLEANER CO., INC., Groveville, New Jersey, has appointed the following western agents: McGee Sales Agency, 75 Fremont St., San Francisco, Calif.; Flickinger, Meyers & Rudolph, 129 West Second St., Los Angeles, Calif., and the Manufacturers Sales-Service, P. O. Box 655, Salt Lake City, Utah. W. A. Ramsay, Ltd., of Honolulu was appointed representative for Hawaii.

CLARENCE C. FRANCK, a junior engineer at the South Philadelphia Works of the Westinghouse Electric and Manufacturing Co., has received the student award for 1928 from the American Society of Mechanical Engineers for a paper entitled, "Condition Curves for Reheat Factors for Steam Turbines."

PLIBRICO JOINTLESS FIREBRICK CO., Chicago, Ill., announces that the contract has just been let for the enlargement of its plant at Trenton, New Jersey.

OWEN D. YOUNG, chairman of the board of the General Electric Co. and of the Radio Corporation of America was named, on November 22, as a trustee of the Teachers College of Columbia University.

BOTFIELD REFRACTORIES CO., Philadelphia, Pa., has appointed as distributor of its products the McCarthy-Jones & Allen Co., Inc., 111 First Ave., South, Nashville, Tenn.

YALE & TOWNE MANUFACTURING CO., Stamford, Conn., dedicated its new service building on December 26. This building is designed to serve as a recreation center for the employees of the company and is known as the Towne Service Building, since funds for its erection were provided by the late chairman of the Board, Henry R. Towne.

PALMER-BEE CO., Detroit, has just placed on the market an entirely new line of herringbone speed reducers. Anti-friction bearings are used throughout; ball bearings on the high speed, Hyatts on the intermediate and Timkens on the slow speed shaft. Gears are continuous-tooth herringbone, with silent Kyser tooth form. The slow speed gears in the double and triple series are divided in the center to permit a more symmetrical arrangement of the gearing and a uniform load on each bearing. No outboard bearings are required for overhung loads up to the maximum rated capacity of the reducer. This feature is one of no little importance when the additional expense and inconvenience of including them in certain drive layouts is considered.

WAGNER ELECTRIC CORP., St. Louis, Mo., announces the addition of N. H. Spencer to its Dallas, Texas, sales force. For the past 8 yr., Mr. Spencer has been with the Pittsburgh Transformer Co., Pittsburgh, Pa.

JOSEPH WILLARD LEGG, one of the foremost engineers in the study of oscillography, died, Jan. 2, in Columbia Hospital, Wilkinsburg, Pa., from pneumonia. He had been ill less than a week.

As a member of the meter engineering staff of the Westinghouse Electric & Manufacturing Co., Mr. Legg was responsible for the development of many electrical devices. His most notable invention was the "Osiso," a small portable oscillograph for which many unusual uses have been found. Another of his inventions is the polar high-speed camera, which is capable of taking 3000 photographs a second. It is used in the study of rapidly-moving electric arcs.

Mr. Legg, who was aged 41 yr., was born in Worcester, Mass., where he attended grade and high schools. Following his high school course, he made a trip around the world. In 1915, he received a Bachelor of Science degree from Worcester Polytechnic Institute; in 1917, a degree of Electrical Engineer from the same institution.

In 1915, he entered the employ of the Westinghouse Co. His first work was in the research department, where he assisted in the development of the mercury arc rectifier. Becoming interested in oscillograph work, he made a number of improvements in oscillograph design, notably the use of incandescent rather than arc lamps.

Mr. Legg leaves his wife, Mrs. Esther Bergstrom Legg, and two children. He resided at 1409 Marlboro St., Wilkinsburg.

W. B. FOSHAY CO. of Minneapolis, Minnesota, on December 28 completed purchase of the Mullen Water Works of Mullen, Idaho.

MAGNETIC MANUFACTURING CO., Milwaukee, Wis., announces that, effective January 1, 1929, its products will bear the trade name "Stearns" in addition to the former trade name "High Duty." No change will be made in the company title.

GENERAL REFRACTORIES CO. has opened a new district sales office at Boston, Mass., located in Room 509, Marshall Building, 40 Central St. The office will be in charge of Nelson W. Bowman, formerly of the New York office of General Refractories Co.

MR. AND MRS. HENRY SIMS, 162 East 21st St., Erie, Pa., celebrated their sixtieth wedding anniversary on December 14 at a banquet held in the Lawrence Hotel, Erie, Pa. Their children, grandchildren and relatives to the number of fifty were present to offer their congratulations. Mr. Sims has been for many years the active head of The Sims Co.

BUDA CO., Harvey, Ill., announces that it has placed on the market a new Buda M. A. N. 6-cylinder, 6½ by 7¾, 180-hp. high-speed, light-weight, full Diesel engine, with all equipment, except the clutch. This

6-cylinder engine weighs approximately 5400 lb. The overall length is 89 in. and the height is 58 in. The engine is started by a small, air-cooled, two-cylinder engine mounted on a bracket cast on the flywheel housing. Instead of this engine, however, an electric starter can be furnished if desired. The normal operating speed of the engine is 1000 r.p.m.

ARMSTRONG MANUFACTURING CO., Springfield, Ohio, has been incorporated to take over the business, management and operation of the old Armstrong Mfg. Co. The new company will continue manufacturing the original Armstrong products and from time to time will add other equipment for the power plant field. It has appointed O. L. Ballard, 1505 South Mint St., Charlotte, N. C., as agent for the states of North and South Carolina and R. R. Gurney, 8906 Euclid Avenue, Cleveland, Ohio, as agent for that territory.

MRS. ADA BRIGGS SCHUCHARDT, wife of R. F. Schuchardt, president of the American Institute of Electrical Engineers and electrical engineer of the Commonwealth Edison Co., Chicago, died at the family home of pneumonia on Monday morning, December 24. She had been ill only two days, being stricken with influenza, which developed rapidly into pneumonia. Besides her husband Mrs. Schuchardt is survived by a daughter, Betty, and son, William.

IN CONNECTION with the semi-annual meeting of the American Society of Mechanical Engineers in Salt Lake City, Utah, July 1—4, 1929, an important feature is the elaborate scheme of excursions. The copper mines and smelters, the Great Salt Lake and the canyons near the city will provide interesting trips. The program of papers will deal with aeronautical development, the smelting industry, low-grade copper mining and possibly the beet-sugar industry. The committee in charge is composed of N. L. Stewart, Austen Gudmundsen, F. W. McEntire, George A. Parker, Leonard Cahoon, Woodworth Anderson, Herbert Landes and W. H. Trask, Jr.

Inspired by the success of the Transcontinental Tour of 1926 and the Great Lakes Tour of 1928, the American Society of Mechanical Engineers is now planning a six national park tour. The schedule will include the six largest and most important of the national parks; namely, Rocky Mountain Estes Park, Grand Canyon, Zion Canyon, Bryce Canyon, Yellowstone Park and Glacier Park. In addition, the carefully selected itinerary includes the Royal Gorge, the Hanging Bridge, Colorado Springs, Glenwood Springs, Pike's Peak and many other scenic features. As the tour is now planned, it will take 30 days and cover approximately 8000 mi. of which 2000 will be by automobile. It will include sixteen states in this country and in the Dominion of Canada.

The tour is to be arranged on the all expense plan and will cost approximately $585 per person. Further detailed information may be obtained from the headquarters of the A. S. M. E., 29 West 39th St., New York City.

IOWA electric utility corporations are planning construction and reconstruction of 1000 mi. of high tension transmission lines, Joe Carmichael, director of the Iowa committee on public utility information, announced recently. In nearly all instances the extensions will reach communities that are not now served by utility concerns. Transmission lines now cover 11,000 mi., reaching all but 26 of the 922 cities and towns of the state. None of these centers, not now served, has a population of more than 300. Increased power production in 1928 amounted to 100,000 kw-hr.

NORTHWESTERN ELECTRIC CO., Portland, Ore., has approved plans for an addition to its local electric generating plant on Lincoln Street, used largely for auxiliary service in connection with its hydroelectric developments. It is proposed to increase the capacity of the plant from 20,000 to 40,000 kw. Guy W. Talbot is president of the company.

SANITARY DISTRICT of Chicago has plans under way for a new pumping plant at Racine Ave. and 39th St., reported to cost more than $3,500,000 with machinery. E. J. Kelly is chief engineer and T. J. Crowe is president of the Sanitary District.

TENTATIVE PLANS are now being made for the Knoxville meeting of the American Society of Mechanical Engineers to be held March 21, 22 and 23 at Knoxville, Tenn. The subjects of the technical program are water-power development, light-metal industries, coal carbonization, executive training and the resources of the Southern Appalachian area. As a special attraction, a tip will be provided to Kingsport, Tenn., which ten years ago was a bare mountain village but now has the largest plant in the world making complete books, a wood by-product plant, a glass works, textile mills and a cement plant. Special arrangements are being made for the students' part in this meeting by R. C. Matthews, national secretary of Tau Beta Pi and E. P. Carpenter, chairman of the Greenville Section, A. S. M. E. The committee in charge consists of C. E. Ferris, W. J. Savage, William Whaley, W. E. Biggs and J. A. Switzer. W. R. Woolrich is in charge of the program.

THE NEWLY-FORMED Diesel Society of America, incorporated under the laws of the State of New York, with offices at Room 408, 26 Court St., Brooklyn, New York, reports an increase in its administration officials. Joseph F. Pinkham, chief engineer of the MS. Twin City of the Detroit-New York Transit Co., has been elected deputy secretary for the Michigan District. Walter Knudsen has been appointed deputy secretary for naval affairs and Richard A. Meyer has been appointed field secretary for the district of New Jersey. The president of the Society is Julius Rosbloom.

TWELFTH EXPOSITION of Chemical Industries will be held at the Grand Central Palace, New York City, from May 6 to 11, 1929, according to a recent announcement. The exposition is intended to draw together chemists, engineers, manufacturers and many others interested from forty industries which are dependent in their operations upon a chemical change in the nature of the material or which may be under chemical control.

NOMINATING COMMITTEE of the American Institute of Electrical Engineers has nominated the following official ticket of candidates for the offices falling vacant August 1, 1929: For president: Harold B. Smith, professor of electrical engineering, Worcester Polytechnic Institute, Worcester, Mass. For vice-presidents, Middle Eastern District: E. C. Stone, system development manager, Duquesne Light Co., Pittsburgh, Pa.; Southern District, W. S. Rodman, professor of electrical en-

gineering, University of Virginia, University, Va.; North Central District, Herbert S. Evans, dean, college of engineering, professor of electrical engineering, University of Colorado, Boulder, Colo.; Pacific District, C. E. Fleager, assistant vice president, Pacific Telephone & Telegraph Co., San Francisco, Calif.; Canadian District, C. E. Sisson, transformer engineer, Canadian General Electric Co., Ltd., Toronto, Ontario. For directors: J. E. Kearns, electrical engineer, General Electric Co., Chicago, Ill.; William S. Lee, vice president and chief engineer, Duke Power Co., Charlotte, N. C.; Charles E. Stephens, district manager, Westinghouse Electric & Mfg. Co., New York, N. Y. For national treasurer: George A. Hamilton, electrical engineer (retired), Elizabeth, N. J.

UNITED STATES CIVIL SERVICE COMMISSION announces open competitive examinations for mechanical draftsmen, assistant mechanical draftsmen and junior mechanical draftsmen at salaries of $1800, $1620, and $1440 a year respectively. Applications for these positions must be on file at the office of the Commission at Washington not later than January 23. Full information may be obtained from the Commission at Washington or from the secretary of the board of examiners at the post office or custom house in any city.

Catalog Notes

COOLERS AND HEATERS for air and gases are discussed in an attractively illustrated bulletin 12-G, just sent out by Schutte and Koerting Co., Philadelphia, Pa. Cooling of compressed air is discussed and data are presented on inter and after coolers for air compressors, with diagrams and charts for calculating the heat given up to the equipment and tables of sizes and capacities. The bulletin then discusses applications for air coolers and describes air heaters for heating air or gases, using live steam, exhaust steam or hot water as the heating medium.

FLEXIBLE SHAFT EQUIPMENT and portable rotary motions for driving grinders, tools and other equipment are described in a recent 8-page bulletin by the Stow Manufacturing Co., Inc., Binghamton, New York.

"WHAT IS THE LIFE of Metallic Packing?" is the question asked and answered in a recent four-page folder sent out by France Packing Co., Tacony, Philadelphia, Pa.

ADSCO VARIATORS, which are packless expansion joints, are described and illustrated in detail in a recent bulletin issued by American District Steam Co., North Tonawanda, N. Y.

CONOWINGO HYDROELECTRIC PLANT is described in an attractive 32-page book, illustrated with impressive photographs, many of them in colors, recently issued by Stone & Webster, Inc., 49 Federal St., Boston, Mass. The book describes the construction of this great project and gives many historical data of interest in connection with the site upon which it is built.

AMONG THE new publications issued recently by the Westinghouse Electric and Mfg. Co., the following are of particular interest: Circular No. 1815 on Automatic Hydroelectric Stations; leaflet L-20386 descriptive of Type CS Linestart squirrel cage motors; leaflet L-20394 descriptive of Class II-200 Linestarters, and leaflet L-20331-A on Types SC and SCT distribution transformers. The first mentioned publication, i.e., Circular 1815, contains a discussion of prime movers, of the relative advantages of synchronous and induction type generators, of applications of vertical and horizontal generators and of braking and governor requirements.

"MEGGER" Insulation Testing instruments are described and illustrated in catalog 1205 just issued by James G. Biddle, 1211 Arch St., Philadelphia, Pa. It gives the principle of operation, details of construction and combinations into sets for various purposes.

STURTEVANT TEMPERVANE HEATING UNITS both floor and ceiling types, for heating industrial buildings, are described in detail and are illustrated in catalog No. 363 just issued by B. F. Sturtevant Co., Hyde Park, Boston, Mass.

QUESTIONS AND ANSWERS regarding vertical feather-valve compressors are given in bulletin No. L-620-Bl by Worthington Pump and Machinery Corp., 2 Park Ave., New York City.

THERMIX STACKS for power plant use are described in Catalog No. 14, issued by the Prat-Daniel Corp., 183 Madison Ave., New York City. The catalog shows installations of various types of stacks, presents data on the new type of cinder eliminating unit, type 4, and gives tables of dimensions and charts for calculating the proper sizes.

REVISED SECOND EDITION of bulletin No. 12 on application of pulverized coal to steam boilers and to industrial plants has recently been issued by Kennedy-Van Saun Manufacturing and Engineering Corp., 2 Park Ave., New York City. The bulletin, which is well illustrated with photographs of installations and working drawings, gives data on various installations of the company's products, describes new types of boilers, presents data on marine applications of pulverized coal and gives tables of engineering data.

DUNHAM HAND BOOK, No. 414, is a 270-page reference book profusely illustrated and containing a great deal of engineering information about heating systems. Details of the Dunham differential system are given, with piping layouts and tables of sizes, while vacuum return systems, radiator connections and details of traps, valves and fittings are given full attention. The book is published by C. A. Dunham Co., 450 E. Ohio St., Chicago, Ill.

"BIGGER PROFITS begin with Modernization" is the title of a folder issued by the Reeves Pulley Co., Columbus, Indiana, telling how machinery can be modernized by making it adjustable in speed.

INDEX TO A. S. T. M. STANDARDS and Tentative Standards as of September 1, 1928, are contained in a recent catalog issued by the American Society for Testing Materials, 1315 Spruce St., Philadelphia, Pa.

WATER-TUBE BOILERS of all-steel sectional type are described in detail with many illustrations of typical installations in Catalog No. 28 just issued by Springfield Boiler Co., Springfield, Ill.

WORKING MODEL showing how the Yarway floatless water column operates is being issued by the Yarnall-Waring Co. Chestnut Hill, Philadelphia, Pa.